I. UNIVERSITY VISION AND MISSION

Wawasan

Mentransformasikan Pengajian Tinggi untuk Kelestarian Hari Esok

Misi

USM merupakan universiti perintis, intensif penyelidikan rentas bidang yang memperkasakan bakat masa depan dan mengupayakan golongan terkebawah demi mentransformasi kesejahteraan sosioekonomi mereka.

Vision

Transforming Higher Education for a Sustainable Tomorrow

Mission

USM is a pioneering, transdisciplinary research intensive university that empowers future talents and enables the bottom billions to transform their socio-economic well-being

II. STUDENT'S PERSONAL INFORMATION

Full Name	
Identity Card (IC)/Passport No.	
Current Address	
Permanent Address	
E-mail Address	
Telephone No. (Residence)	
Mobile Phone No. (if applicable)	
School	
Programme of Study	

III.

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IV. ACADEMIC CALENDAR 2017/2018

FOR ALL SCHOOLS (EXCEPT THE SCHOOL OF MEDICAL SCIENCES AND SCHOOL OF DENTAL SCIENCES)

***Registration for New Students (3 September 2017) / Orientation Week 3-10 September 2017**

SEM	WEEK	ACTIVITY	DATE	REMARKS
ONE	1	Teaching & Learning Period (T&LP - 5 Weeks)	Monday, 11.09.2017 - Sunday, 17.09.2017	01.09.2017, Friday - Eid-ul adha 09.09.2017, Saturday – Agong's Birthday
	2		Monday, 18.09.2017 - Sunday, 24.09.2017	16.09.2017, Saturday - Malaysia Day
	3		Monday, 25.09.2017 - Sunday, 01.10.2017	22.09.2017, Friday - Maal Hijrah 1439
	4		Monday, 02.10.2017 - Sunday, 08.10.2017	
	5		Monday, 09.10.2017 - Sunday, 15.10.2017	
	6	Mid Semester Break	Monday, 16.10.2017 - Sunday, 22.10.2017	18.10.2017, Wednesday - Deepavali**
	7	Teaching & Learning Period (T&LP - 9 Weeks)	Monday, 23.10.2017 - Sunday, 29.10.2017	
	8		Monday, 30.10.2017 - Sunday, 05.11.2017	
	9		Monday, 06.11.2017 - Sunday, 12.11.2017	
	10		Monday, 13.11.2017 - Sunday, 19.11.2017	
	11		Monday, 20.11.2017 - Sunday, 26.11.2017	
	12		Monday, 27.11.2017 - Sunday, 03.12.2017	01.12.2017, Friday - Prophet Muhammad's Birthday
	13		Monday, 04.12.2017 - Sunday, 10.12.2017	
	14		Monday, 11.12.2017 - Sunday, 17.12.2017	
	15		Monday, 18.12.2017 - Sunday, 24.12.2017	
	16	Revision Week	Monday, 25.12.2017 - Sunday, 31.12.2017	25.12.2017, Monday-Christmas
	17	Examinations (3 Weeks)	Monday, 01.01.2018 - Sunday, 07.01.2018	01.01.2018, Monday-New Year 2018
	18		Monday, 08.01.2018 - Sunday, 14.01.2018	
	19		Monday, 15.01.2018 - Sunday, 21.01.2018	
	20	Mid Semester Break (3 Weeks)	Monday, 22.01.2018 - Sunday, 28.01.2018	
	21		Monday, 29.01.2018 - Sunday, 04.02.2018	31.01.2018. Wednesday-Thaipusam**
	22		Monday, 05.02.2018 - Sunday, 11.02.2018	
TWO	1/23	Teaching & Learning Period (T&LP - 7 Weeks)	Monday, 12.02.2018 - Sunday, 18.02.2018	16 & 17.02.2018, Friday & Saturday - Chinese New Year
	2/24		Monday, 19.02.2018 - Sunday, 25.02.2018	
	3/25		Monday, 26.02.2018 - Sunday, 04.03.2018	
	4/26		Monday, 05.03.2018 - Sunday, 11.03.2018	
	5/27		Monday, 12.03.2018 - Sunday, 18.03.2018	
	6/28		Monday, 19.03.2018 - Sunday, 25.03.2018	
	7/29		Monday, 26.03.2018 - Sunday, 01.04.2018	
	8/30	Mid Semester Break	Monday, 02.04.2018 - Sunday, 08.04.2018	
	9/31	Teaching & Learning Period (T&LP – 7 Weeks)	Monday, 09.04.2018 - Sunday, 15.04.2018	
	10/32		Monday, 16.04.2018 - Sunday, 22.04.2018	
	11/33		Monday, 23.04.2018 - Sunday, 29.04.2018	
	12/34		Monday, 30.04.2018 - Sunday, 06.05.2018	01.05.2018, Tuesday - Labour Day
	13/35		Monday, 07.05.2018 - Sunday, 13.05.2018	
	14/36		Monday, 14.05.2018 - Sunday, 20.05.2018	
	15/37		Monday, 21.05.2018 - Sunday, 27.05.2018	Examinations start on 23.05.2018 - 13.06.2018
	16/38	Examinations (3 Weeks)	Monday, 28.05.2018 - Sunday, 03.06.2018	29.05.2018, Tuesday - Wesak Day 02.06.2018, Saturday - Nuzul Al-Quran
	17/39		Monday, 04.06.2018 - Sunday, 10.06.2018	
	18/40		Monday, 11.06.2018 - Sunday, 17.06.2018	15 & 16.06.2018, Friday & Saturday - Eid-ul fitr**

COURSE DURING THE LONG VACATION (KSCP)

SEM	WEEK	ACTIVITY		DATE					REMARKS
C D L V / K S C P	19/41	Long Vacation/ Industrial Training/ KSCP (10 Weeks)		Monday,	18.06.2018	-	Sunday,	24.06.2018	
	20/42			Monday,	25.06.2018	-	Sunday,	01.07.2018	
	21/43			Monday,	02.07.2018	-	Sunday,	08.07.2018	07.07.2018, Saturday - Penang Heritage & Penang Governor's Birthday
	22/44		*T&LP	Monday,	09.07.2018	-	Sunday,	15.07.2018	
	23/45			Monday,	16.07.2018	-	Sunday,	22.07.2018	
	24/46		*Examination	Monday,	23.07.2018	-	Sunday,	29.07.2018	28.07.2018, Saturday – Agong's Birthday
	25/47			Monday,	30.07.2018	-	Sunday,	05.08.2018	
	26/48			Monday,	06.08.2018	-	Sunday,	12.08.2018	
	27/49			Monday,	13.08.2018	-	Sunday,	19.08.2018	
	28/50			Monday,	20.08.2018	-	Sunday,	26.08.2018	22.08.2018, Wednesday- Eid-ul-adha**
	29/51			Monday,	27.08.2018	-	Sunday,	02.09.2018	31.08.2018, Friday - National Day

1.0 INTRODUCTION

This Engineering Handbook is specially prepared for the undergraduate engineering students of Universiti Sains Malaysia who will commence their first year studies in the academic year of 2017/2018.This handbook contains concise information that will prove useful in helping students to understand the university's system of study as well as to adopt oneself to university life.

Information in this handbook covers various aspects such as the programme structure of the Bachelor of Engineering degree, the academic system, types of courses, synopsis of the courses, student status, examination and evaluation system, information about the engineering schools, reference materials and academic staff list. This information would give a clear picture to the students for them to plan their academic studies, understand the field of studies that they are following and adapt themselves to the teaching and learning environment of the university.

Universiti Sains Malaysia offers Bachelor of Engineering (with Honours) programmes through its six schools of engineering:

- School of Aerospace Engineering
- School of Chemical Engineering
- School of Civil Engineering
- School of Electrical and Electronic Engineering
- School of Materials and Mineral Resources Engineering
- School of Mechanical Engineering

1.1 History and Development

In 1972, Universiti Sains Malaysia established the School of Applied Science at the Main Campus in Penang and offered basic fields of engineering studies. The fields of studies offered at the time were Electronic Technology, Polymer Technology, Food Technology, Materials Technology and Mineral Resources Technology.

In 1984, the School of Applied Science was restructured and given a new name, the School of Engineering Science and Industrial Technology. This restructuring, which corresponded to the development of Malaysia's Industrial Masterplan that is in turn related to the country's human utilization needs, gave birth to three new schools. They were the School of Industrial Technology which focused on offering studies in fields such as polymer and food technologies, the School of Electrical and Electronics Engineering and the School of Materials and Mineral Resources Engineering.

The expansion that took place required an increase in the physical space of the campus. Since the physical area of USM in Penang at the time was rather limited, a new area in the state of Perak was identified as the site for the development of a branch campus.

A decision was reached whereby all fields of engineering studies were transferred to Perak while the School of Industrial Technology remained in Penang. In 1986, the School of Electrical and Electronics Engineering and the School of Materials and Mineral Resources Engineering moved to a temporary campus at the old Ipoh Town Council building while waiting for the construction of the USM branch campus in Bandar Baru Seri Iskandar, Perak Tengah District, Perak to be completed. The temporary campus was named USM Perak Branch Campus (USMKCP – USM Kampus Cawangan Perak).

In 1987, construction began at the site of USM Perak Branch Campus in Bandar Baru Seri Iskandar. On 1st January 1989, the scope of engineering studies was expanded further with the establishment of two new schools of engineering: the School of Civil Engineering and the School of Mechanical Engineering.

By the end of November 1989, all four USM engineering schools began moving to USM Perak Branch Campus in Seri Iskandar in stages and the moving process finally ended in April 1990. The Ipoh Town Council building which housed USM's temporary campus was handed back to the Town Council in a glorious ceremony that was graced by the DYMM Seri Paduka Baginda Yang Dipertuan Agong, Sultan Azlan Shah.

In 1992, USM established its fifth engineering school, the School of Chemical Engineering. Two years later, efforts to offer studies in the field of Aerospace Engineering went underway. On 17th of May 1998, the USM Aerospace Engineering Unit was established and on the 1st of March 1999 the unit was upgraded to the School of Aerospace Engineering.

In 1997, the government decided to transfer USMKCP back to Penang. The new campus site was located in Seri Ampangan, Nibong Tebal, Seberang Perai Selatan, Penang while USMKCP's campus site in Seri Iskandar was taken over by the Universiti Teknologi Petronas (UTP).

The Engineering Campus moved in stages in 2001. USM's Engineering Campus in Seri Ampangan, Nibong Tebal began its operations in the 2001/2002 Academic Session in June 2001.

In 2007, USM was appointed as one of the four research universities by the Ministry of Higher Education [MoHE] through a rigorous evaluation process thus elevating its status to the top among more than 100 public and private universities and colleges in Malaysia. In the same year, USM was rated as the only "excellent" (or 5-Star) university in the Academic Reputation Survey conducted by the Malaysian Qualification Agency (MQA).

On 4th of September 2008, USM was granted with an APEX (the Accelerated Programme for Excellence) status by the Malaysian's government. This status

requires USM to transform its system in order to move up its World University Rankings with a target of top 100 in five years and top 50 by 2020.

USM's transformation plan, entitled "Transforming Higher Education for a Sustainable Tomorrow" will embark on numerous transformational journeys, including revamping most of its activities pertaining to nurturing and learning, research and innovation, services, students and alumni and the management of the university as a whole.

The University takes steps to improve the three core pillars of its strengths, [i] concentration of talent, [ii] resources and [iii] acculturation of supportive governance.

1.2 Philosophy and Objective

The philosophy and objective of the Bachelor of Engineering programme at the Universiti Sains Malaysia is to produce qualified engineering graduates in various fields who are able to find solutions to diverse problems through innovative thinking.

The engineering programme at USM aims to produce professional engineers who are responsible towards research and development, project management, production planning and control and accreditation of equipments in various fields in the country.

Thus all courses that are being offered in the engineering programme blend together the theoretical and practical aspects of learning according to the relevant needs of the industrial public sectors. The fields of engineering studies in USM are up to date and challenging so as to fulfil the nation's industrial development needs. Students will also be equipped with fundamentals of business practice such as finance, marketing and management as well as co-curricular activities so that the students could adapt themselves well to the current state of affairs.

1.3 Outcome Based Education

All bachelor engineering programmes at the Universiti Sains Malaysia have adopted the Outcome Based Education (OBE) since the academic year of 2006/2007. The OBE emphasises that the professional attributes of the graduates satisfy the current and future needs of the country and global market in general. For this, the programme educational objectives of each programme offered at the Engineering Schools are developed through interviews and surveys from the stakeholders including industries, government, parents, students, alumni and the university lecturers. This signifies that the programmes offered in USM are relevance to the current need of industries and society and for the preparation of high quality future talents.

With the agreed programme educational objectives, the curricular structure of each programme is planned accordingly to ensure that our graduate possess the quality attributes as suggested by the Engineering Accreditation Council (EAC) and Board of Engineer Malaysia (BEM) are achieved. The attributes are:

1) Ability to apply knowledge of mathematics, science and chemical engineering fundamentals to solve complex chemical engineering problems.
2) Ability to analyse complex engineering problems and formulate the solution using literature.
3) Ability to solve complex chemical engineering problems with consideration for public, health, safety, cultural, societal and environmental issues.
4) Ability to conduct investigation into complex problems using research-based knowledge and research methods in the field of chemical engineering.
5) Ability to design and evaluate the performance of complex chemical engineering activities using modern engineering and IT tools.
6) Ability to apply engineering and management principles in engineering projects.
7) Ability to assess the environmental and societal impact due to professional engineering solutions and demonstrate the need for sustainable development.
8) Ability to apply contextual knowledge in assessing societal, health, safety, legal and cultural issues and apply ethical principles relevant to engineering practice.
9) Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
10) Ability to communicate effectively on complex engineering activities with fellow engineers and the society at large.
11) Ability to function effectively in multidisciplinary settings, as an individual or group member with the capacity to be a leader.
12) Ability to recognize the need to undertake lifelong learning and acquire the capacity to do so in the broadest context of technological change.

1.4 Continuous Quality Improvement System

To realize the Outcome Based Education, a few mechanisms have been identified to be incorporated into the continuous quality improvement system for the Bachelor of Engineering programmes. Feedbacks are obtained from industries through the Industrial Advisory Panel which consist of at least five engineers or managers from industrial sectors.

Feedbacks from the students are obtained from the Lecturer-Student Committee and Interview Session with each student before their convocation. Feedbacks from the alumni are obtained from the USM Alumni Relations Unit and the School's alumni communities such as email, webpage and Facebook. All these feedbacks are incorporated for deliberations and approval by the Curriculum Review Committee which convenes annually to identify any particular course or programme that need to be revamped or to undergo minor/major changes.

1.5 External Examiner

Universiti Sains Malaysia has appointed external examiners to:

- Advise the School/Centre concerned regarding matters pertaining to the structure and contents of its undergraduate programmes, research and administration related to examinations. Attention is also focused towards post-graduate programmes where applicable.
- Scrutinise and evaluate all draft question papers prepared by Internal Examiners.
- Visit the university during the period of the examinations in order to be familiar with the work of the School/Centre, the available physical facilities and also to participate in activities related directly to the conduct of the examinations. In order to make the visit more meaningful and to obtain a better understanding of the University, an External Examiner who has been appointed for a term of three academic sessions should visit the school/centre during the first academic session of his appointment.
- Scrutinise and evaluate such answer scripts as may be required by the Dean/Director of the School/Centre concerned and to ensure that the standards set by Internal Examiners (of the discipline to which he/she is appointed) are the same as those at other Universities of International standing.
- Ensure uniformity in the evaluation of answer scripts by the Internal Examiners between candidates of the same standard.
- Examine the oral component or viva-voce where required.
- Hold seminars/meetings with the academic staffs/students if required.

1.6 Industry Advisory Board

The engineering schools have set up an Industrial Advisory Board for all offered engineering programmes and various meetings have and will be conducted from time to time. Each school has appointed prominent members from the industry and relevant institutions to be in the Advisory Board. The Industrial Advisory Board members will discuss and give their input on the Industrial Training; Outcome Based Education (OBE) implementation, curriculum development, the requirement of soft skills and other relevant issues to the School to improve the quality of programmes and graduates.

1.7 Industry and Community Network

To foster closer, effective, meaningful and sustainable linkages and partnership with the industry and the community, i.e. the world outside Universiti Sains Malaysia, a new division, the Division of Industry & Community Network was established

within the Chancellory in September 2007. This new division is headed by a Deputy Vice Chancellor (Industry and Community Network). The function of this division is to match between the knowledge/expertise, facilities and resources of the university to the needs, aspirations and expectations of the industry and the community to result in a win-win situation.

1.8 Stakeholder

In line with the Engineering Accreditation Council (EAC) requirements for involvement of stakeholders in establishing the programme educational objectives, their inputs have been continuously gathered from surveys and direct communications. The University has identified the stakeholders as follows:

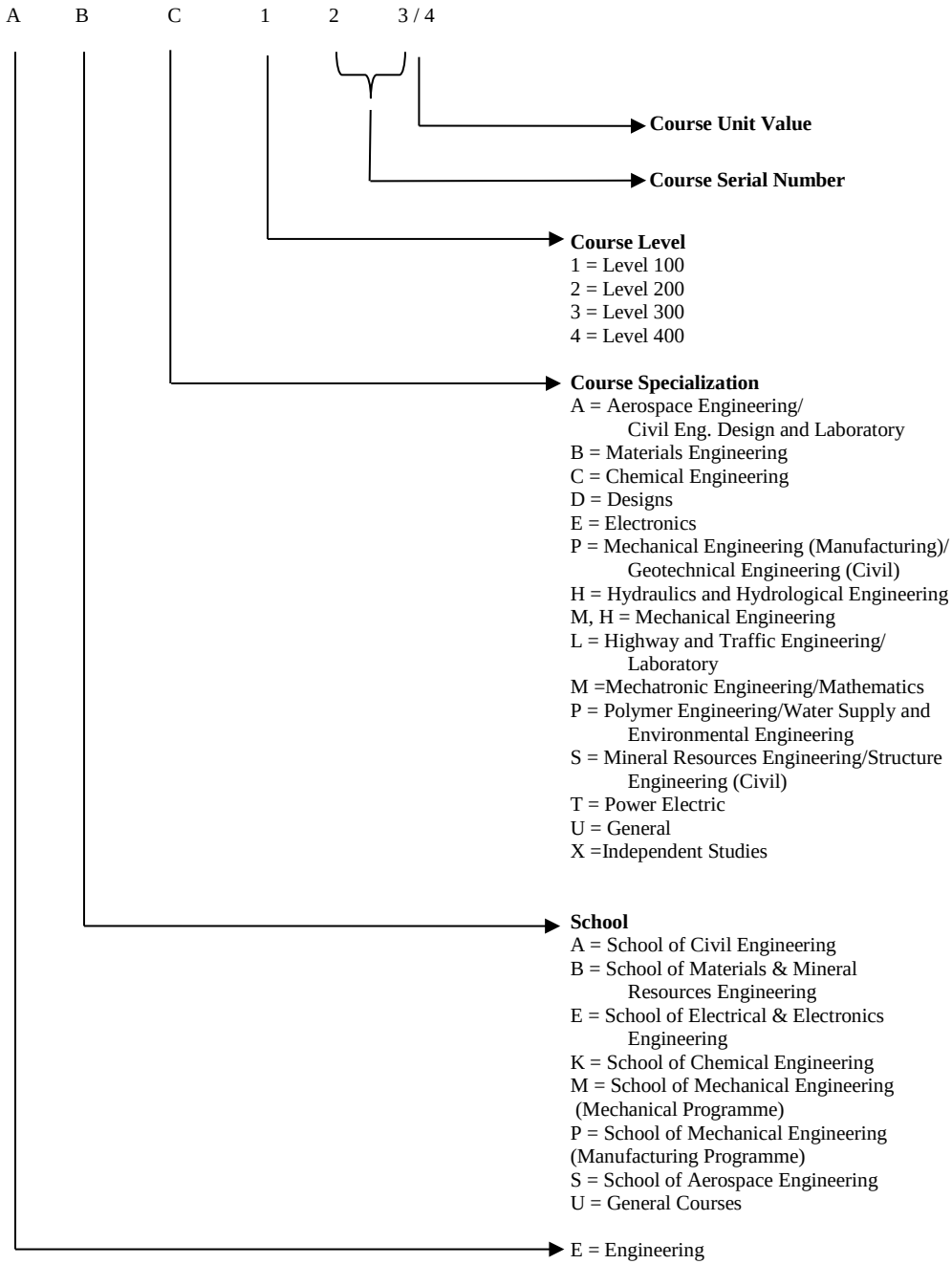
- Academic Staffs (University)
- Employers (industry and government)
- Alumni
- Students
- Parents

1.9 Teaching Delivery Method

Other contributing components to the curriculum such as a variety of teaching and learning (delivery) modes, assessment and evaluation methods are designed, planned and incorporated within the curriculum to enable students to effectively develop the range of intellectual and practical skills, as well as positive attitudes. The assessments to evaluate the degree of the achievement of the Programme Outcomes by the students are done both at the programme as well as at course levels. The teaching and learning methods designed enable students to take full responsibility for their own learning and prepare themselves for lifelong learning and knowledge acquisition.

1.10 Course Code

Each course offered by the respective School is denoted by the following code of ABC 123/4. The alphabets and numbers represent:-



1.11 Programme Structure

The Structure of the Engineering Degree Programme is as follows:-

	COURSE	UNITS	REMARKS
(i)	CORE	108	
(ii)	ELECTIVE	12	Students may select these courses from the list as determined by the respective school.
(iii)	UNIVERSITY REQUIREMENTS	15	
	Compulsory (12 units)		
	(a) Bahasa Malaysia	2	
	(b) English Language	4	
	(c) Islamic and Asian Civilisations	2	
	(d) Ethnic Relations	2	
	(e) Entrepreneurship	2	
	Optional Course (3 Units)		
	(a) Co-curriculum/Optional/ Skills	3	
	TOTAL:	**135**	

Note:

For graduation, students are required to complete at least 135 units, with 'pass' grade for all the courses.

1.12 Courses Offering

Students are required to register for the undergraduate courses in two semesters for each academic session that is Semester 1 and Semester 2. Courses are offered and examined in the same semester. Courses offered are categorized into four levels, via levels 100, 200, 300 and 400, suitable to the requirements of a four-year study programme.

Core Courses

Core course is a compulsory course package which aims at giving a deeper understanding of an area of specialization/major. Students need to accumulate 108 units of the core courses which have been identified by each school.

Elective Courses

Students who do not choose a Minor area are required to take Elective courses. Students need to accumulate no less than 12 units from the list of courses suggested and acknowledged by the school.

Optional Courses

Optional courses are courses chosen by the students from among those that are outside of their programmes of study.

The main objective of an Optional course is as a substitute course for students who do not take Co-curriculum courses or Skill/Analysis courses.

Audit Courses

In principle, the university allows students to register for any courses on an audit basis for the purpose of enhancing the students' knowledge in specific fields during the duration of their study. However, the units of any such audit courses will not be taken into consideration for graduation purposes.

The registration procedures for courses on an audit basis are as follows:-

(a) Students can register for courses on an audit basis for the purpose of augmenting his/her knowledge in specific fields. Registration for the said course must be within the course registration week.

(b) Only students of active status are allowed to register for courses on an audit basis.

(c) Courses registered for on an audit basis are designated as code 'Y' courses. This designation will be indicated on the relevant academic transcript. A space at the bottom of the academic transcript will be reserved for listing the courses registered for on an audit basis.

(d) Courses registered for on an audit basis will not be taken into consideration in determining the minimum and maximum units of courses registered for.

(e) Students must fulfil all course requirements. Student who register for courses on an audit basis, are not obligated to sit for any examinations pertaining to that course. A grade 'R' will be awarded irrespective as to whether the student had or had not sat for the examination.

Laboratory Work/Practical, Engineering Practice and Industrial Training

Programmes in the School of Engineering place a great emphasis on laboratory work/practical. Laboratory work/practical is an important and essential aspect in most courses. There are also courses that the assessment is based on 100% works in laboratory work/practical. It aims to provide students with a better understanding of the subject matter delivered through lectures.

Students are required to submit laboratory/practical reports which are part of the course work assessment for courses delivered through lectures and the laboratory/practical component only. Attendance is compulsory for all levels of study and students may be barred from taking the written examination if their attendance is unsatisfactory.

Apart from attending classes (lectures and laboratory/practical), students must also undergo the Engineering Practice Course and Industrial Training.

General Objectives of Engineering Practice

(a) To expose to the students about the importance and the link between the theoretical and practical aspects of engineering, and to familiarise them with the environment/theoretical situations in use, available resources and their scarcity so that the academic aspects of a course can be understood better and used more effectively.

(b) To raise awareness of the environment/industrial situations, practices, resources and their scarcity. Therefore, students will have the opportunity to equip themselves to face future challenges in their academic studies as well as in their future training.

The Engineering Practice will be conducted in the following manner:

The training will be conducted on and off campus. There are two levels which are compulsory for all engineering students:

(i) Engineering Practice Course

The Engineering Practice Course is a basic training course on mechanical, manufacturing and electrical engineering. The training includes engineering workshops, introduction to manufacturing processes and electrical circuit. Engineering students will also be exposed to methods of engineering planning and project implementation. The duration of the training is 14 weeks and during this period, students will be supervised by the academic staff on duty.

(ii) Industrial Training

This course is conducted over 10 weeks during the long break after Semester II at level 300. Students are exposed to the actual operations of industries, locally and abroad. It is hoped that students will be able to learn and experience useful knowledge and skills while undergoing training as they have already taken the Engineering Practice Course.

It is hoped that the training will provide students with a good foundation in engineering. This is a 5-unit course and students will be awarded a Pass/Fail grade upon completion.

1.13 Requirements for Graduation for Chemical Engineering Programme

Following are the requirements for graduation for Bachelor of Engineering (Hons) (Chemical Engineering):-

(i) Complete at least 135 units.
(ii) Pass all courses with minimum grade of C.
(iii) Obtain Cumulative Grade Point Average (CGPA) of 2.0 and above for all courses.
(iv) Obtain CGPA (A&T) of 2.0 and above for basic and core courses.

2.0 ACADEMIC SYSTEM AND GENERAL INFORMATION

2.1 Course Registration

Registration of courses is an important activity during the period of study at the university. It is the first step for the students to sit for the examination at the end of each semester. Signing up for the right courses each semester will help to facilitate the graduation of each student from the first semester till the final semester.

2.1.1 Course Registration Secretariat for the Bachelor Degree and University's Diploma Students

Student Data and Records Section (SDRP)
Academic Management Division
Registry
(Level 1, Chancellory Building)

Tel. No.	:	04-653 2925/2924/2923
Fax No.	:	04-657 4641
E-Mail	:	sdrp@usm.my
Website	:	http://registry.usm.my/updr

The SDRP office is the Secretariat/Coordinator of course registration for the Bachelor Degree and Diploma Programme of the University.

Further inquiries regarding course registration activities for the first degree and diploma can be made at the office of the Student Data and Records Section. Please refer to the contact number above.

2.1.2 Course Registration Platform

(i) *E-Daftar* (E-Registration)

E-Daftar is a platform for on-line course registration. The registration is done directly through the Campus Online portal **(https://campusonline.usm.my)**.

Registration under *E-Daftar* for Semester 1 usually starts 1-2 days after the release of 'Official' examination results of Semester 2 of the previous academic year. The system closes a day before Semester 1 begins (in September). *E-Daftar* registration for Semester 2 usually starts 1-2 days after the Semester 1 'Provisional' examination results are released until a day before Semester 2 begins (in February).

The actual timing of registration under *E-Daftar* will be announced by the Student Data and Records Section during the Revision Week of every semester and will be displayed on the respective Schools/Centres/Hostels' bulletin boards and in the USM's official website.

Under *E-Daftar*, students can register for any courses offered by USM, except co-curriculum courses. Registration of co-curriculum courses is still placed under the administration of the Director of the Centre for Co-Curriculum Programme at the Main Campus or the Coordinator of the Co-Curriculum Programme at the Engineering Campus and the Coordinator of the Co-Curriculum Programme at the Health Campus.

Co-Curriculum courses will be included in the students' course registration account prior to the *E-Daftar* activity, if their pre-registration application is successful.

(ii) Access to *E-Daftar* System

a. *E-Daftar* System can be accessed through the Campus Online portal **(https://campusonline.usm.my)**.
b. Students need to use the E-Mail ID and password to access their profile page, which includes the *E-Daftar* menu.
c. Students need to click on the *E-Daftar* menu to access and register for the relevant courses.
d. Students are advised to print the course registration confirmation slip upon completion of the registration process or after updating the course registration list (add/ drop) within the *E-Daftar* period.
e. The *E-Daftar* system can only be accessed for a certain period of time.
f. Guidelines to register/gain access to the *E-Daftar* portal are available at the Campus Online portal's main page.

(iii) Online Course Registration (OCR) in Schools/Centres

OCR activities are conducted in the Schools/Centres and are applicable to students who are academically active and under Probation (P1/P2) status. Students who face difficulties registering their courses during the *E-Daftar* period can register their courses during the official period of OCR alternatively. Each school is responsible for scheduling this activity.

The official period for OCR normally starts on the first day of the semester (without the penalty charge of RM50.00). After this official date, the registration will be considered late (a penalty of RM50.00 will be imposed if no reasonable excuse is given).

During the non-penalty period, OCR will be conducted at each School. After Week Six, all registration, including adding and dropping of courses will be administered by the Examination and Graduation Section Office (Academic Management Division, Registry).

2.1.3 The Frequency of Course Registration in One Academic Session

(i) Normal Study Semester
- 2 times per year (beginning of Semester **1** & Semester **2**)

(ii) Long semester break (about one month after the final examination of Semester **2**)
- Once per year

2.1.4 General Guidelines before Students Register for Courses

(i) Matters/Information/Documents required to be noted/considered/ referred to by students before course registration:

- Refer to the respective School's website to get updated information for courses offered or course registration.
- Decide on courses to be registered according to the semester as stipulated in the Study Programme Guide Book.
- List of courses to be registered and number of units (unit value) for each course.
- Provide Cumulative Statement of Grades (Cangred).
- Construct Teaching and Learning Timetable for the registered courses (to avoid overlapping in timetable).
- Read and comprehend the reminders regarding policies/general requirements for the course registration.

(ii) The number of maximum and minimum units that can be registered in every semester **is** stated below:

Academic Status	Minimum Units	Maximum Units
Active	9	21
P1	9	12
P2	9	10

Determination of academic status in a semester is based on the students' academic performance in the previous semester (Grade Point Average, GPA):

* GPA 2.00 & above = Active Academic Status
* GPA 1.99 & below = Probation Academic Status (P1/P2)

- Students who meet the minimum period of residency (6 semesters for a 3 year programme, 7 semesters for a 3.5 year programme or 8 semesters for a 4 year programme) are allowed to register courses with a total of less than 9 units. The semester in which the student is on leave is not considered for the residency period.

(iii) Type of course codes during registration:

T = Core courses
E = Elective courses
M = Minor courses
U = University courses

} Grade and number of units obtained from these courses are considered for graduation

Two (2) other course codes are:
Y = audit courses
Z = prerequisite courses

Grade and number of units obtained from these courses are not considered for graduation.

(iv) Advice and approval of the Academic Advisor

- Approval from the Academic Advisor is required for students under Probation status before they are allowed to register during the OCR period. Probation students cannot access *E-Daftar* for registration.
- Approval from the Academic Advisor is not required for students under Active Status to register courses through *E-Daftar*.

(v) Students are not allowed to register and repeat any course for which they have achieved a grade 'C' and above.

2.1.5 Information/Document Given To All Students through Campus Online Portal (https://campusonline.usm.my)

(i) The information of Academic Advisor.

(ii) Academic information such as academic status, GPA value, CGPA value and year of study.

(iii) Cangred and Course Registration Form.

(iv) List of courses offered by all Schools/Centres.

(v) Teaching and Learning Timetable for all Schools/Centres/Units from the three campuses.

(vi) List of pre-registered courses which have been added into the students' course registration record (if any).

(vii) Reminders about the University course registration policies/general requisites.

2.1.6 Registration of Language and Co-Curriculum Courses

(a) Registration of Language courses through *E-Daftar* is allowed.

- ❖ However, if any problem arises, registration for language courses can still be carried out/updated during the official period of OCR at the office of the School of Languages, Literacies and Translation.

- ❖ All approval/registration/dropping/adding of language courses is under the responsibility and administration of the School of Languages, Literacies and Translation.

- ❖ Any problems related to the registration of language courses can be referred to the School of Languages, Literacies and Translation. The contact details are as follows:

General Office	: 04-653 4542/ 5243/ 5248	for Main Campus students
Malay Language Programme Chairperson	: 04-6533974	
English Language Programme Chairperson	: 04-6533406	
Foreign Language Programme Chairperson	: 04-6533396	
Engineering Campus Programme Chairperson	: 04-5995407	
	: 04-5996385	
Health Campus Programme Chairperson	: 09-7671252	

(b) Registration for **co-curricular courses through *E-Daftar*** is not allowed.

- ❖ Registration for co-curricular courses is either done through pre-registration before the semester begins or during the first/second week of the semester. Co-curricular courses will be included in the students' course registration account prior to the *E-Daftar* activity, if their pre-registration application is successful.

- ❖ All approval/registration/dropping/adding of co-curricular courses is under the responsibility and administration of:

  Director of the Centre for Co-Curricular Programme, Main Campus (04-653 5242/5243/5248)

  Coordinator of the Centre for Co-Curricular Programme, Engineering Campus (04-599 5097/6385)

  Coordinator of the Centre for Co-Curricular Programme, Health Campus (09-767 7547)

(c) **Dropping of Language and Co-Curriculum courses, if necessary, must be made within the first week**. After the first week, a fine of RM50.00 will be imposed.

2.1.7 Registration of 'Audit' Courses (Y code)

Registration for the 'Audit' course (Y code) **is not allowed in the *E-Daftar***. It can only be done during the official period of OCR in the School or Centre involved. Students who are interested must complete the course registration form which can be printed from the Campus Online Portal or obtained directly from the School. Approval from the lecturers of the courses to be audited and the Dean/ Deputy Dean (Academic) (signed and stamped) in the course registration form is required.

Registration of 'Audit' courses (Y code) is not included in the calculation of the total registered workload units. Grades obtained from 'Audit' course are not considered in the calculation of CGPA and total units for graduation.

2.1.8 Registration of Prerequisite Courses (Z code)

Registration of Prerequisite courses (Z code) is included in the total registered workload (units). Grades obtained from the Prerequisite courses are not considered in the calculation of CGPA and units for graduation.

2.1.9 Late Course Registration/Late Course Addition

Late course registration or addition is not allowed after the official period of the OCR ends unless with valid reasons. General information on this matter is as follows:

(i) **Late course registration and addition are only allowed in the first to the third week** with the approval of the Dean. Students will be fined RM50.00 if the reasons given are not acceptable.

(ii) Application to add a course **after the third week** will not be considered, except for special cases approved by the University.

2.1.10 Dropping of Courses

Dropping of courses is allowed until the **end of the sixth week**.

For this purpose, students must meet the requirements set by the University as follows:

(i) Dropping Course Form must be completed by the student and signed by the lecturer of the course involved and the Dean/Deputy Dean of their respective Schools and submitted to the general office of the School/Centre which is responsible for offering the courses involved.

(ii) Students who wish to drop a language course must obtain the signature and stamp of the Dean of the School of Languages, Literacies and Translation, as well as the signature and stamp of the Dean of their respective schools.

(iii) Students who wish to drop the Co-Curriculum courses must obtain the approval of the Centre for Co-Curriculum Programme and the signature and stamp of the Dean of their respective schools.

(iv) The option for dropping courses cannot be misused. Lecturers have the right not to certify the course that the student wishes to drop if the student is not serious, such as poor attendance record at lectures, tutorials and practical, as well as poor performance in coursework. The student will be barred from sitting for the examination and will be given grade 'X' and is not allowed to repeat the course during the *Courses during the Long Vacation* (KSCP) period.

2.1.11 Course Registration Confirmation Slip

The course registration confirmation slip that has been printed/ obtained after registering the course should be checked carefully to ensure there are no errors, especially the code type of the registered courses. Any data errors for course registration must be corrected immediately whether during the period of *E-Daftar* (for students with active status only) or during the period of OCR at the Schools.

2.1.12 Revising and Updating Data/Information/Students' Personal and Academic Records

Personal and academic information for each student can be checked through the Campus Online portal (https://campusonline.usm.my).

Students are advised to always check all the information displayed on this website.

- The office of the Student Data and Records Section must be notified of any application/notification for correction/updating of personal data such as the spelling of names (names must be spelled as shown on the Identification Card), Identification Card number and address (permanent address and correspondence address).

- The office of the Student Data and Records Section must be notified of any application/ notification for correction of academic data such as information on Major, Minor, MUET result and the course code.

- The office of the Examination and Graduation Section must be notified of any application/notification for correction of the examination/results data.

2.1.13 Academic Advisor

Each School will appoint an Academic Advisor for each student. Academic Advisors comprise academic staff (lecturers) of the school. Normally, the appointment of Academic Advisors will be made known to every student during the first semester in the first year of their studies.

Academic Advisors will advise their students under their responsibility on academic-related matters. **Important advice for the students includes the registration planning for certain courses in each semester during the study period**. Before registering the course, students are advised to consult and discuss with their Academic Advisors to determine the courses to be registered in a semester.

2.2 Interpretation of Unit/Credit/Course

2.2.1 Unit

Each course is given a value, which is called a **UNIT**. The unit is determined by the scope of its syllabus and the workload for the students. In general, a unit is defined as follows:

Type of Course	Definition of Unit
Theory	1 unit is equivalent to 1 contact hour per week for 13 – 14 weeks in one semester
Practical/Laboratory/ Language Proficiency	1 unit is equivalent to 1.5 contact hours per week for 13 – 14 hours in one semester
Industrial Training/ Teaching Practice	1 unit is equivalent to 2 weeks of training

Based on the requirements of Malaysian Qualifications Framework (MQF):

One unit is equivalent to 40 hours of student learning time

[1 unit = 40 hours of Student Learning Time (SLT)]

2.2.2 Accumulated Credit Unit

Units registered and passed are known as credits. To graduate, students must accumulate the total number of credits stipulated for the programme concerned.

2.3 Examination System

Examinations are held at the end of every semester. Students have to sit for the examination of the courses they have registered for. Students are required to settle all due fees and fulfil the standing requirements for lectures/tutorials/practical and other requirements before being allowed to sit for the examination of the courses they have registered for. Course evaluation will be based on the two components of coursework and final examinations. Coursework evaluation includes tests, essays, projects, assignments and participation in tutorials.

2.3.1 Duration of Examination

Evaluated Courses	Examination Duration
2 units	1 hour for coursework of more than 40%
2 units	2 hours for coursework of 40% and below
3 units or more	2 hours for coursework of more than 40%
3 units or more	3 hours for coursework of 40% and below

2.3.2 Barring from Examination

Students will be barred from sitting for the final examination if they do not fulfil the course requirements, such as absence from lectures and tutorials of at least 70%, and have not completed/fulfilled the required components of coursework. Students will also be barred from sitting for the final examination if they have not settled the academic fees. A grade 'X' would be awarded for a course for which a student is barred. Students will not be allowed to repeat the course during the *Courses during the Long Vacation* (KSCP) period.

2.3.3 Grade Point Average System

Students' academic achievement for registered courses will be graded as follows:

Alphabetic Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Grade Points	4.00	3.67	3.33	3.00	2.67	2.33	2.00	1.67	1.33	1.00	0.67	0

Students awarded with a grade 'C-' and below for a particular course would be given a chance to improve their grades by repeating the course during the KSCP (see below) or normal semester. Students awarded with a grade 'C' and above for a particular course will not be allowed to repeat the course whether during KSCP or normal semester.

The achievement of students in any semester is based on Grade Point Average (GPA) achieved from all the registered courses in a particular semester. GPA is the indicator to determine the academic performance of students in any semester.

CGPA is the Cumulative Grade Point Average accumulated by a student from one semester to another during the years of study.

The formula to compute GPA and CGPA is as follows:

$$\text{Grade Point Average} = \frac{\sum_{i=1}^{n} U_i M_i}{\sum_{i=1}^{n} U_i}$$

where:

n	=	Number of courses taken
U_i	=	Course units for course i
M_i	=	Grade point for course i

Example of calculation for GPA and CGPA:

	Course	Unit	Grade Point (GP)	Grade (G)	Total GP
Semester I	ABC XX1	4	3.00	B	12.00
	ABC XX2	4	2.33	C+	9.32
	BCD XX3	3	1.67	C-	5.01
	CDE XX4	4	2.00	C	8.00
	EFG XX5	3	1.33	D+	3.99
	EFG XX6	2	2.67	B-	5.34
		20			43.66

$$GPA = \frac{43.66}{20} = 2.18$$

	Course	Unit	Grade Point (GP)	Grade (G)	Total GP
Semester II	ABC XX7	3	1.00	D	3.00
	ABB XX8	4	2.33	C+	9.32
	BBC XX9	4	2.00	C	8.00
	BCB X10	4	2.67	B-	10.68
	XYZ XX1	3	3.33	B+	9.99
		18			40.99

$$GPA = \frac{40.99}{18} = 2.28$$

$$CGPA = \frac{\text{Total Accumulated GP}}{\text{Total Accumulated Unit}} = \frac{43.66 + 40.99}{20 + 18} = \frac{84.65}{38} = 2.23$$

From the above examples, the CGPA is calculated as the total grade point accumulated for all the registered courses and divided by the total number of the registered units.

2.3.4 Courses During the Long Vacation *(Kursus Semasa Cuti Panjang)* (KSCP)

KSCP is offered to students who have taken a course earlier and obtained a grade of 'C-', 'D+', 'D', 'D-', 'F' and 'DK' only. Students who

have obtained a grade 'X' or 'F*' are not allowed to take the course during KSCP.

The purpose of KSCP is to:

(i) Give an opportunity to students who are facing time constraints for graduation.
(ii) Assist students who need to accumulate a few more credits for graduation.
(iii) Assist "probationary" students to enhance their academic status.
(iv) Assist students who need to repeat a prerequisite course, which is not offered in the following semester.

However, this opportunity is only given to students who are taking courses that they have attempted before and achieved a grade as stipulated above, provided that the course is being offered. Priority is given to final year students. Usually, formal lectures are not held, and teaching is via tutorials.

The duration of KSCP is 3 weeks, i.e. 2 weeks of tutorial and 1 week of examination, all held during the long vacation. The KSCP schedule is available in the University's Academic Calendar.

The Implementation of KSCP

(i) Students are allowed to register for a maximum of 3 courses and the total number of units registered must not exceed 10.

(ii) Marks/grades for coursework are taken from the highest marks/the best grades obtained in a particular course in the normal semester before KSCP. The final overall grade is determined as follows:

Final Grade = The best coursework marks or grade +
Marks or grade for KSCP examination

(iii) GPA calculation involves the **LATEST** grades (obtained in KSCP) and also involves courses taken in the second semester and those repeated in KSCP. If the GPA during KSCP as calculated above is 2.00 or better, the academic status will be active, even though the academic status for the second semester was probation status. However, if the GPA for KSCP (as calculated above) is 1.99 or below, the academic status will remain as probation status for the second semester.

(iv) Graduating students (those who have fulfilled the graduation requirements) in the second semester are not allowed to register for KSCP.

2.3.5 Academic Status

Active Status: Any student who achieves a GPA of 2.00 and above for any examination in a semester will be recognised as ACTIVE and be allowed to pursue his/her studies for the following semester.

Probation Status: A probation status is given to any student who achieves a GPA of 1.99 and below. A student who is under probation status for three consecutive semesters (P1, P2, FO) will not be allowed to pursue his/her studies at the university. On the other hand, if the CGPA is 2.00 and above, the student concerned will be allowed to pursue his/her studies and will remain at P2 status.

2.3.6 Termination of Candidature

Without any prejudice to the above regulations, **the University Examination Council has the absolute right to terminate any student's studies if his/her academic achievement does not satisfy and fulfil the accumulated minimum credits.**

The University Examination Council has the right to terminate any student's studies due to certain reasons (a student who has not registered for the courses, has not attended the examination without valid reasons), as well as medical reasons can be disqualified from pursuing his/her studies.

2.3.7 Examination Results

A provisional result (pass/fail) through the Campus Online portal (campusonline.usm.my) and short message service (SMS) will usually be released and announced after the School Examination Council meeting and approximately one month after the final examination.

Enquiries regarding full results (grade) can be made through the Campus Online portal and short message service (SMS). The results will be released and announced after the University Examination Council meeting and is usually two weeks after the provisional results are released.

Students can print their official semester results document namely 'SEMGRED' through the portal "*Campus Online*" (campusonline.usm.my) during the second week of the following semester.

2.4 Unit Exemption

2.4.1 Unit Exemption

Unit exemption is defined as the total number of units given to students who are pursuing their studies in USM that are exempted from the graduation requirements. Students only need to accumulate the remaining units for graduation purposes. Only passes or course grades accumulated or acquired in USM will be included in the calculation of the Cumulative Grade Point Average (CGPA) for graduation purposes.

2.4.2 Regulations and Implementation of Unit Exemption

Diploma holders from recognised Public and Private Institutions of Higher Learning:

(i) Unit exemption can only be given to courses taken at diploma level.

(ii) Courses for unit exemption may be combined (in two or more combinations) in order to obtain exemption of one course at degree level. However if the School would like to approve only one course at the diploma level for unit exemption of one course at degree level, the course at diploma level must be equivalent to the degree course and have the same number of or more units.

(iii) Courses taken during employment (in service) for diploma holders cannot be considered for unit exemption.

(iv) The minimum achievement at diploma level that can be considered for unit exemption is a minimum grade 'C' or 2.0 or equivalent.

(v) The total number of semesters exempted should not exceed two semesters.

(vi) **In order to obtain unit exemption for industrial training**, a student must have continuous work experience for at least two years in the area. If a student has undergone industrial training during the period of diploma level study, the student must have work experience for at least one year. The students are also required to produce a report on the level and type of work performed. Industrial training unit exemption cannot be considered for semester exemption as the industrial training is carried out during the long vacation in USM.

(vii) Unit exemption for university and option courses can only be given for courses such as Bahasa Malaysia (LKM400), English Language, Islamic and Asian Civilisations and as well as co-curriculum.

IPTS (Private Institution of Higher Learning) USM Supervised/ External Diploma Graduates:

- Students who are IPTS USM supervised/external diploma graduates are given unit exemption as stipulated by the specific programme of study. **Normally, unit exemption in this category is given as a block according to the agreement** between USM (through the School that offers the programme) with the IPTS.

Students from recognised local or foreign IPTA (Public Institutions of Higher Learning)/IPTS who are studying at the Bachelor's Degree level may apply to study in this university and if successful, may be considered for unit exemption, subject to the following conditions:

(i) Courses taken in the previous IPT are equivalent (at least 50% of the course must be the same) to the courses offered in USM.

(ii) Students taking courses at Advanced Diploma level in IPT that are recognised to be equivalent to the Bachelor's Degree course in USM may be considered for unit exemption as in Section 2.5.

(iii) The total maximum unit exemption allowed should not exceed one third of the total unit requirement for graduation.

2.4.3 Total Number of Exempted Semesters

Semester exemption is based on the total units exempted as below:

Total Units Exempted	Total Semesters Exempted
8 and below	None
9 – 32	1
33 to 1/3 of the total units for graduation	2

2.4.4 Application Procedure for Unit Exemption

Any student who would like to apply for unit exemption is required to complete the Unit Exemption Application Form which can be obtained from the Examination and Graduation Section or the respective Schools.

The form must be approved by the Dean of the School prior to submission to the Examination and Graduation Section for consideration and approval.

2.5 Credit Transfer

Credit transfer is defined as the recognition of the total number of credits obtained by USM students taking courses in other IPTAs (Public Institution of Higher Learning) within the period of study at USM, and is combined with credits obtained at USM to fulfil the unit requirements for his/her programme of study. The transferred examination results or grades obtained in courses taken at other IPTAs will be taken into consideration in the Cumulative Grade Point Average (CGPA) calculation.

(a) Category of Students Who Can Be Considered for Credit Transfer

USM full-time Bachelor Degree level students who would like to attend specific Bachelor Degree level courses at other IPTAs.

USM full-time diploma level students who would like to attend specific diploma level courses at other IPTAs.

(b) Specific Conditions

(i) Basic and Core Courses

Credit transfer can only be considered for credits obtained from other courses in other IPTAs that are equivalent (at least 80% of the content is the same) with the courses offered by the programme.

Courses that can be transferred are only courses that have the same number of units or more. For equivalent courses but with less number of units, credit transfers can be approved by combining a few courses. Credits transferred are the same as the course units offered in USM. Average grade of the combined courses will be taken into account in the CGPA calculation.

(ii) Elective or Option Courses

Students may take any appropriate courses in other IPTAs subject to permission from the School as well as the approval of the IPTAs.

The transferred credits are credits obtained from courses at other IPTAs. No course equivalence condition is required.

(iii) Minor Courses

For credit transfer of minor courses, the School should adhere to either conditions (i) or (ii), and take into account the programme requirement.

(c) General Conditions

1) The total maximum units transferred should not exceed one third of the total number of units for the programme.

2) Credit exemption from other IPTAs can be considered only once for each IPTA.

3) The examination results obtained by a student who has taken courses at other IPTAs will be taken into account for graduation purposes. Grades obtained for each course will be combined with the grades obtained at USM for CGPA calculation.

4) Students who have applied and are approved for credit transfer are not allowed to cancel the approval after the examination result is obtained.

5) Students are required to register for courses at other IPTAs with not less than the total minimum units as well as not exceeding the maximum units as stipulated in their programme of study. However, for specific cases (e.g. students on an extended semester and only require a few units for graduation), the Dean may allow such students to register less than the minimum units and the semester will not be considered for the residential requirement. In this case, the CGPA calculation will be similar to that requirement of the KSCP.

6) USM students attending courses at other IPTAs who have failed in any courses will be allowed to re-sit the examinations of the courses if there is such a provision in that IPTA.

7) If the method of calculation of examination marks in the other IPTAs is not the same as in USM, grade conversions will be carried out according to the existing scales.

8) USM students who have registered for courses at other IPTAs but have decided to return to study in USM must adhere to the existing course registration conditions of USM.

2.5.1 Application Procedure for Attending Courses/Credit Transfer

USM students who would like to apply to attend courses/credit transfer at other IPTAs should apply using the Credit Transfer Application Form.

The application form should be submitted for the Dean's approval for the programme of study at least three months before the application is submitted to other IPTAs for consideration.

2.6 Academic Integrity

"Integrity without knowledge is weak and useless. Knowledge without integrity is dangerous and dreadful." - Samuel Johnson

Academic honesty in academic is important because it is the main pillar in ensuring that manners and ethics with regards to high academic integrity are preserved.

Universiti Sains Malaysia encourages its students to be respectful of and to ensure that any matter relating to academic integrity will be well-preserved. Universiti Sains Malaysia always encourages its students to ensure that manners, ethics and integrity would be essential in academics while focusing on their studies in Universiti Sains Malaysia.

These are practices or acts that are considered as conducts which lack integrity in academics:

(a) Cheating

Cheating in the context of academics include copying in examinations, unauthorized use of information or other aids in any academic exercise without authorization or in a non-sincere manner. There are numerous ways and methods of cheating which include:

- Copying answers from others during a test or an exam.
- Any suspicious action that can be described as cheating or an attempt to cheat in an exam.
- Using unauthorized materials or devices without authorization (calculator, PDA, mobile phones, pager, or any smart device, and other unauthorized devices) during a test or an exam.
- Asking or allowing another student to take a test or an exam on behalf and vice-versa.
- Sharing answers or programmes for an assignments or projects.
- Purposely tampering with marked/graded after it has been returned, and then re-submitting it for remarking/regrading.

- Give command, to force, persuade, deceive or blackmail others to conduct research, do writing, programming or any task for personal gain.
- Submitting any identical or similar work in more than one course without consulting or prior permission from the lecturers concerned.

(b) Plagiarism

The reputation of an academic institution depends on the ability to achieve and sustain academic excellence through the exercise of academic integrity. Academic integrity is based on honesty, trust, fairness, respect, and responsibility, which form the basis of academic work.

One aspect of the loss of academic integrity is due to plagiarism, which is the act of presenting published and unpublished ideas, writings, works or inventions of others in written or other medium, as one's own original intellectual endeavours without any clear acknowledgement of or reference to the author of the source.

A substantial portion of academic work and research are in the written form and the university is committed in the deterrence of plagiarism.

POLICY ON PLAGIARISM OF UNIVERSITI SAINS MALAYSIA

The University Policy on Plagiarism describes USM's strong commitment to uphold academic integrity in relation to plagiarism. It will come into effect when there is an infringement of academic conduct relating to plagiarism.

This policy acts as a guideline that both educates and prevents and can be used as the basis if anyone that is part of the university violates any rules and laws of the University.

The policy applies to all students, former students, staff and former staff which include fellows, post-doctorates, visiting scholars, as well as academic, non-academic, research, contract and temporary staff who study, serving or having served, or have graduated from the University.

Plagiarism is defined as the act of presenting, quoting, copying, paraphrasing or passing off ideas, images, processes, works, data, personal words or those of other people or sources without any proper acknowledgement, reference to or quotation of the original source(s). The acts of plagiarism include, but are not limited to, the following:

- Quoting verbatim (word-for-word replication of) works of other people.

- Paraphrasing another person's work by changing some of the words, or the order of the words, without due acknowledgement of the source(s).
- Submitting another person's work in whole or in part as one's own.
- Auto-plagiarising or self-plagiarism (one's own work or previous work) that has already been submitted previously for assessment, or for any other academic award and admitting it as newly-produced without citing the original content.
- Insufficient or misleading referencing of the source(s) that would enable the reader to check whether any particular work has indeed been cited accurately and/or fairly and thus to identify the original writer's particular contribution in the work submitted.

The University will take action of every report and offences relating to plagiarism and if the student is found guilty, the student can be charged by the university according to the Students Disciplinary Rules.

(c) Fabrication

Fabrication refers to a process of invention, adaptation or copying with the intention of cheating. This is an act of deceiving other people. Fabrication is somewhat related to matters which have been 'created' or altered.

Invention or task outcome or academic work without acknowledgement, alteration, falsification or misleading use of data, information or citation in any academic work constitutes fabrication. Fabricated information neither represent the student's own effort nor the truth concerning a particular investigation or study, and thus violating the principle of truth in knowledge. Some examples are:

- Creating or exchanging data or results, or using someone else's results, in an experiment, assignment or research.
- Citing sources that are not actually used or referred to.
- Listing with intent, incorrect or fictitious references.
- Forging signatures of authorization in any academic record or other university documents.
- Developing a set of false data.

(d) Collusion

Collusion refers to the cooperation in committing or to commit or to do work with negative intentions. Some examples of collusion include:

- Paying, bribing or allowing someone else to do an assignment, test/exam, project or research for you.

- Doing or assisting others in an assignment, test/exam, project or research for something in return.
- Permitting your work to be submitted as the work of others.
- Providing material, information or sources to others knowing that such aids could be used in any dishonest act.

(e) Other violations relating to academic integrity

- Arriving late to lecture, tutorial, class or other forms of teaching relating to their courses.
- Sending or submitting any overdue assignment relating to their courses.
- Hire someone else to do the assignment or thesis.
- Carrying out business by providing service to write assignment or thesis of the students.
- Any other violations that USM considers as violating academic integrity.

2.6.1 Consequences of Violating Academic Integrity

Students are responsible in protecting and upholding academic integrity in USM.

If in any specific event a student or students would encounter any incident that denotes academic dishonesty, the student(s) need to submit a report to the relevant lecturer. The lecturer is then responsible to investigate and substantiate the violation and report the matter to the Dean of the School.

(i) If any violation of academic integrity is considered as not of a serious nature, the Dean of the School can take administrative action on the students.

(ii) However, if the violation is deemed serious by the School, this matter will be brought to the attention of the University Disciplinary Committee for appropriate measures to be taken.

(iii) If a student is caught copying or cheating in an examination, the Investigation Committee on Copying/Cheating in Examinations will pursue the matter according to the university's procedures. If the investigation found that there is a case, the student(s) will be brought to the Secretariat of University Student Disciplinary Committee (Academic Cases) at Legal Office, Level 2, Building E42, Chancellory II, Universiti Sains Malaysia. Regarding this matter, the Universiti Sains Malaysia (Discipline of Students) Rules will be enforced.

(iv) Measure 48 Measure Universiti Sains Malaysia (Discipline of Students) Rules provides that a student who had committed an inappropriate conduct and is found guilty could be sentenced with either or a combination of or other suitable penalty as listed:

(a) a warning ;
(b) a fine not exceeding two hundred ringgit;
(c) exclusion from any specific part or parts of the University for a specified period;
(d) suspension from being a student of the University for a specified period;
(e) expulsion from the University.

(v) Any student(s) found guilty and is to be suspended from their studies within a given duration by the University Disciplinary Committee (Academic Matters) or the University Disciplinary Committee (General Matters), the maximum suspension period will not be accounted for them in the completion of their studies and while waiting for the verdict to be read.

2.7 USM Mentor Programme

The Mentor Programme acts as a support-aid that involves staff undergoing special training as consultants and guides to the USM community who would like to share their feelings and any psychosocial issues that could affect their social activities. This programme helps individuals to manage psychosocial issues in a more effective manner, which will eventually improve their well-being in order to achieve a better quality of life.

Objectives

(a) To serve as a co-operation and mutual assistance mechanism for dealing with stress, psychosocial problems and many more in order to ensure the well-being of the USM community.

(b) To inculcate the spirit of unity and the concept of helping one another by appointing a well-trained mentor as a social agent who promotes a caring society for USM.

(c) To produce more volunteers to assist those who need help.

(d) To prevent damage in any psychosocial aspect before they reach a critical stage.

2.8 Student Exchange Programme

2.8.1 Study Abroad Scheme

The student exchange programme is an opportunity for USM students to study for one or two semesters abroad at any USM partner institutions. Ideally, students are encouraged to participate in the exchange programme within their third to fifth semester (3 year degree programme) and within the third to seventh semester (4 year degree programme).

USM students who wish to follow the SBLN programme must discuss their academic plans with the Dean or Deputy Dean of their respective Schools and also with the International Mobility & Collaboration Centre (IMCC) (to ensure that credits obtained from the external higher education institution can be transferred as part of the credit accumulation for graduation).

Any student that follows the SBLN programme and violates any disciplinary act in the external higher education institution, can be penalised in accordance with the University (Discipline of Students) Rules if the matter is referred to USM.

For further information, please visit www.imcc.usm.my or contact the International Mobility and Collaboration Centre (IMCC) at +604 – 653 2777/2774.

2.8.2 Student Exchange Programme in Local Higher Education Institutions (RPPIPT)

This is a programme that allows students of Higher Learning Institutions to do an exchange programme for a semester among the higher institutions themselves. Students can choose any relevant courses and apply for credit transfers.

USM students who want to participate in RPPIPT have to discuss their academic plans with the Dean or Deputy Dean of their respective Schools as well with the Academic Collaboration Unit, Division of Academic and International (to ensure that credits obtained from the higher education institution in Malaysia can be transferred as part of the credit accumulation for graduation).

Any student who participates in RPPIPT and violates any of the institution's displinary rules can be penalised according to the

University (Discipline of Students) Rules if the matter is referred to USM.

For further information, please visit http://bheaa.usm.my/index.php/programmes/inter-university-exchange or contact the Academic Collaboration Unit of the Academic and International Division at +604 – 653 2451.

2.9 Ownership of Students' Dissertation/Research Project/Theses and University's Intellectual Property

2.9.1 Ownership of Students' Dissertation/Research Project/Theses and University's Intellectual Property

The copyright of a dissertation/research project/thesis belongs to the student. However, as a condition for the conferment of a degree, the student gives this right unconditionally, directly but not exclusively, and free of royalties to the university to use the contents of the work/thesis for teaching, research and promotion purposes. In addition, the student gives non-exclusive rights to the University to keep, use, reproduce, display and distribute copies of the original thesis with the rights to publish for future research and the archives.

3.0 UNIVERSITY REQUIREMENTS

3.1 Summary of University Requirements

Students are required to take 15 - 22 units of the following University/Option courses for University requirements:

	University Requirements	Units
1	Bahasa Malaysia	2
2	English Language	4
3	Local Students • Islamic and Asian Civilisations (TITAS) (2 Units) • Ethnic Relations (2 Units) • Core Entrepreneurship* (2 Units) International Students • Malaysian Studies (4 Units) • Option/ Bahasa Malaysia/ English Language (2 Units)	6
4	Co-curricular /Skills Courses/Foreign Language Courses/Options Students have to choose one of the following: • Co-curricular** (1-10 Units) • Skills Courses/ Foreign Language Courses/Options	3 – 12
	Total	**15 – 22**

* Students from Schools which have a similar course as this are exempted from taking this course. The units should be replaced with an option course.

** Students from the School of Educational Studies are required to choose a uniformed body co-curricular package. Registration for co-curricular courses is compulsory for students from the School of Dental Sciences (SDS). The number of co-curricular units that need to be collected is three (3) units. The breakdown is as follows: (i) 2nd year students must register for one (1) unit of the co-curricular course in semester 1. (ii) 3rd year students must register for one (1) unit of co-curricular course in semester 1 AND one (1) unit in semester 2 (further information can be obtained from the SDS Academic Office). Registration for co-curricular courses is compulsory for 1st year students from the School of Medical Sciences (SMS). The number of units that need to be collected for co-curricular courses is two (2) units. The breakdown is as follows: 1st year students must register for one (1) unit of a co-curricular course in semester 1 AND one (1) unit in semester 2 (further information can be obtained from the SMS Academic Office).

Details of the University requirements are given in the following sections.

3.2 Bahasa Malaysia

(a) Local Students

The requirements are as follows:

- LKM400/2 - Bahasa Malaysia IV

All Malaysian students must take LKM400 and pass with the minimum of Grade C in order to graduate.

Entry requirements for Bahasa Malaysia are as follows:

No	Qualification	Grade	Level of Entry	Type	Units	Status
1	(a) SPM/ MCE/ SC (or equivalent qualification) (b) STPM/ HSC (or equivalent qualification)	1 - 6 P/ S	LKM400	U	2	Graduation requirement

Note: To obtain credit units for Bahasa Malaysia courses, a minimum grade of C is required. Students may obtain advice from the School of Languages, Literacies and Translation if they have different Bahasa Malaysia qualifications from the above.

(b) International Students

- International students pursuing Bachelor's degrees in Science, Accounting, Arts (ELLS), Education (TESL), Housing, Building and Planning and English for Professionals.

All international students in this category are required to take the following courses:

Code	Type	Units
LKM100	U	2

- International students (non-Indonesian) pursuing Bachelor's degrees in Arts.

All international students in this category are required to take the following courses:

Code	Type	Units
LKM 100	Z	2
LKM 200	U	2
LKM 300	U	2

- International students (Indonesian) pursuing Bachelor degrees in Arts.

The Bahasa Malaysia graduation requirement for this category of students is as follows:

Code	Type	Units
LKM200	U	2
LKM300	U	2

Note: Students must pass with a minimum grade C for type U courses.

3.3 English Language

All Bachelor degree students must take 4 units of English Language courses to fulfil the University requirement for graduation.

(a) Entry Requirements for English Language Courses

No.	English Language Qualification	Grade	Level of Entry	Status
1	*MUET LSP401/402/403/404 † Discretion of Dean	Band 6 A - C	LHP 451/452/453/454/455/ 456/457/458/459	Compulsory/ Option/Type U (2 Units)
2	*MUET LSP300 † Discretion of Dean	Band 5 A - C	LSP 401/402/403/404	Compulsory/ Type U (2 Units)
3	*MUET LMT100 † Discretion of Dean	Band 4 A - C	LSP300	Compulsory/ Type U (2 Units)
4	*MUET † Discretion of Dean	Band 3/2/1 (Score 0 - 179)	LMT100/ Re-sit MUET	Prerequisite/ Type Z (2 Units)

* MUET: Malaysian University English Test.

† Students may obtain advice from the School of Languages, Literacies and Translation if they have different English Language qualifications from the above.

Note:

- Students are required to accumulate four (4) units of English for graduation.
- In order to obtain units in English Language courses, students have to pass with a minimum grade 'C'.
- Students with a Score of 260 – 300 (Band 6) in MUET must accumulate the 4 units of English from the courses in the post-advanced level (LHP451/452/453/454/455/456/457/ 458/459*). They can also take foreign language courses to replace their English language units but they must first obtain written consent from the Dean of the School of Languages, Literacies and Translation. (Please use the form that can be obtained from the School of Languages, Literacies and Translation).
  [*The number of units for LHP457 is 4 and for LHP451, 452, 453, 454, 455, 456, 458 and 459 is 2].
- Students with a score of 179 and below in MUET are required to re-sit MUET to improve their score to Band 4 or take LMT100 and pass with a minimum grade 'C'.

(b) English Language Courses (Compulsory English Language Units)

The English Language courses offered as University courses are as follows:

No	Code/Unit	Course Title	School (If Applicable)
1	LMT100/2	Preparatory English	Students from all Schools
2	LSP300/2	Academic English	Students from all Schools
3	LSP401/2	General English	Students from: School of Educational Studies (Arts) School of The Arts School of Humanities School of Social Sciences School of Languages, Literacies and Translation
4	LSP402/2	Scientific and Medical English	Students from: School of Biological Sciences School of Physics School of Chemical Sciences School of Mathematical Sciences School of Industrial Technology School of Educational Studies (Science) School of Medical Sciences School of Health and Dental Sciences School of Pharmaceutical Sciences
5	LSP403/2	Business and Communication English	Students from: School of Management School of Communication

No	Code/Unit	Course Title	School (If Applicable)
6	LSP404/2	Technical and Engineering English	Students from: School of Computer Sciences School of Housing, Building and Planning School of Engineering
7	LDN 101/2	English For Nursing I	Students from the School of Health Sciences
8	LDN 201/2	English For Nursing II	Students from the School of Health Sciences

3.4 Local Students - Islamic and Asian Civilisations/Ethnic Relations/Core Entrepreneurship

(a) Islamic and Asian Civilisations (The course is conducted in Bahasa Malaysia)

It is compulsory to pass the following course (with a minimum grade 'C'):

HTU 223 – Islamic and Asian Civilisations (TITAS) (2 units)

This course aims to increase students' knowledge on history, principles, values, main aspects of Malay civilization, Islamic civilization and its culture. With academic exposure to cultural issues and civilization in Malaysia, it is hoped that students will be more aware of issues that can contribute to the cultivation of the culture of respect and harmony among the plural society of Malaysia. Among the topics in this course are Interaction among Various Civilizations, Islamic Civilization, Malay Civilization, Contemporary Challenges faced by the Islamic and Asian Civilizations and Islamic Hadhari Principles.

(b) Ethnic Relations (The course is conducted in Bahasa Malaysia)

It is compulsory to pass the following course (with a minimum grade 'C'):

SHE 101 – Ethnic Relations (2 units)

This course is an introduction to ethnic relations in Malaysia. This course is designed with 3 main objectives: (1) to introduce students to the basic concepts and the practices of social accord in Malaysia, (2) to reinforce basic understanding of challenges and problems in a multi-ethnic society, and (3) to provide an understanding and awareness in managing the complexity of ethnic relations in Malaysia. At the end of this course, it is

hoped that students will be able to identify and apply the skills to issues associated with ethnic relations in Malaysia.

(c) Core Entrepreneurship (The course is conducted in Bahasa Malaysia)

It is compulsory to pass the following course (with a minimum grade 'C'):

WUS 101 – Core Entrepreneurship (2 units)

This course aims to provide basic exposure to students in the field of entrepreneurship and business, with emphasis on the implementation of the learning aspects while experiencing the process of executing business projects in campus. The mode of teaching is through interactive lectures, practical, business plan proposals, execution of entrepreneurial projects and report presentations. Practical experiences through hands-on participation of students in business project management will generate interest and provide a clearer picture of the world of entrepreneurship. The main learning outcome is the assimilation of culture and entrepreneurship work ethics in their everyday life. This initiative is made to open the minds and arouse the spirit of entrepreneurship among target groups that possess the potential to become successful entrepreneurs. By exposing all students to entrepreneurial knowledge, it is hoped that it will accelerate the effort to increase the number of middle-class entrepreneurs in the country.

For more information, please refer to the Co-curriculum Programme Reference Book.

3.5 International Students - Malaysian Studies/Option

(a) Malaysian Studies

It is compulsory for all international students to pass the following course (with a minimum grade 'C'):

SEA205E - Malaysian Studies (4 Units)

This course investigates the structure of the Malaysian system of government and the major contemporary trends in Malaysia. Emphasis will be given to the current issues in Malaysian politics and the historical and economic developments and trends of the country. The discussion begins with a review of the independence process. This is followed by an analysis of the formation and workings of the major institutions of government – parliament, judiciary, bureaucracy, and the electoral and party systems. The scope and extent of Malaysian democracy will be

considered, especially in the light of the current changes and developments in Malaysian politics. The second part of the course focuses on specific issues: ethnic relations, national unity and the national ideology; development and political change; federal-state relations; the role of religion in Malaysian politics; politics and business; Malaysia in the modern world system; civil society; law, justice and order; and directions for the future.

(b) Option/Bahasa Malaysia/English Language (2 Units)

International students need to fulfil another 2 units of an option course or an additional Bahasa Malaysia/English Language course.

3.6 Co-Curriculum/Skills Courses/Foreign Language Courses/Options

Students have to choose one of the following (A/B):

(A) Uniformed/Seni Silat Cekak/Jazz Band Co-curricular Package (6 – 10 Units)

Students who choose to take packaged co-curricular courses are required to complete all levels of the package. It is compulsory for students from the School of Education to choose a uniformed body co-curricular package from the list below (excluding Seni Silat Cekak). The co-curricular packages offered are as follows:

- Palapes (Reserve Officers' Training Corps) Co-curricular Package (10 Units) (3 years)

Palapes Army	**Palapes Navy**	**Palapes Air Force**
WTD103/3	WTL103/3	WTU103/3
WTD203/3	WTL203/3	WTU203/3
WTD304/4	WTL304/4	WTU304/4

- Co-curricular Package (6 Units) (3 years)

Suksis (Students' Police Volunteers)	**Seni Silat Cekak Malaysia**	**Jazz Band**
WPD101/2	WCC123/2	WCC108/2
WPD201/2	WCC223/2	WCC208/2
WPD301/2	WCC323/2	WCC308/2

Kelanasiswa (Rovers)	Bulan Sabit Merah (Red Crescent)	Ambulans St. John (St. John Ambulance)	SISPA (Civil Defence)
WLK102/2	WBM102/2	WJA102/2	WPA103/2
WLK202/2	WBM202/2	WJA202/2	WPA203/2
WLK302/2	WBM302/2	WJA302/2	WPA303/2

(B) Co-curricular/Skills Courses/Options (1 – 6 Units)

All students are encouraged to follow the co-curricular courses and are given a maximum of 6 units for Community Service, Culture, Sports, Innovation and Initiatives and Leadership (Students from the School of Medical Sciences and School of Dentistry are required to register for a specific number of co-curriculum units and at specific times during their academic year (Please refer to subject 3.1 Summary of University Requirements). Students from the School of Education must take the uniformed co-curricular package [excluding Seni Silat Cekak]. Students who do not enrol for any co-curricular courses or who enrol for only a portion of the 3 units need to replace these units with skills/option courses. The co-curricular, skills and option courses offered are as follows:

(i) Community Service, Culture, Sports, Innovation and Initiatives and Leadership Co-curricular Courses

Packaged (Students are required to complete all levels)			
Community Service (2 Years)	**Jazz Band (3 Years)**	**Karate (3 Semesters)**	**Taekwondo (3 Semesters)**
WKM101/2	WCC108/2	WSC108/1	WSC115/1
WKM201/2	WCC208/2	WSC208/1	WSC215/1
	WCC308/2	WSC308/1	WSC315/1
Non-Packaged (1 Semester)			
Culture		**Sports**	
WCC103/1 - Catan (Painting)		WSC105/1 - Bola Tampar (Volley Ball)	
WCC105/1 - Gamelan		WSC106/1 - Golf	
WCC107/1 - Guitar		WSC110/1 - Memanah (Archery)	
WCC109/1 - Koir (Choir)		WSC111/1 - Ping Pong (Table Tennis)	
WCC110/1 - Kraftangan (Handcrafting)		WSC112/1 - Renang (Swimming)	
WCC115/1 - Tarian Moden (Modern Dance)		WSC113/1 - Aerobik (Aerobics)	

WCC116/1 - Tarian Tradisional (Traditional Dance)	WSC114/1 - Skuasy (Squash)
WCC117/1 - Teater Moden (Modern Theatre)	WSC116/1 - Tenis (Tennis)
WCC118/1 - Wayang Kulit Melayu (Malay Shadow Play)	WSC119/1 - Badminton
WCC119/1 - Senaman Qigong Asas (Basic Qigong Exercise)	
Non-Packaged (1 Semester)	
WCC219/1 - Senaman Qigong Pertengahan (Intermediate Qigong Exercise)	WCC124/1 - Sepak Takraw
WCC124/1 - Kompang Berlagu	WSC 125/1 - Futsal
WCC122/1 - Seni Memasak (Culinary Arts)	WSC 126/1 - Bola Jaring (Netball)
WCC127/1 - Kesenian Muzik Nasyid (Nasyid Musical Arts)	WSC 128/1 – Petanque
	WSC 129/1 - Boling Padang (Lawn Bowl)
Innovation & Initiative	WSC 130/1 - Orienteering
WCC103/1 - Catan (Painting)	**Leadership (Kepimpinan)**
WCC110/1 - Kraftangan (Handcrafting)	WSC 127/1 - Pengurusan Acara 1 (Event Management 1)
WCC120/1 - Canting Batik (Batik Painting)	WSC 227/1 - Pengurusan Acara 2 (Event Management 2)
WCC121/1 - Seni Khat (Calligraphic Art)	**Public Speaking**
WCC122/1 - Seni Memasak (Culinary Arts)	WEC 101/1 – Pengucapan Awam
WCC125/1 - Seni Wau Tradisional (Traditional Kite Art)	WEC 101E/1 – Public Speaking
WCC127/1 - Kesenian Muzik Nasyid (Art of Nasheed Music)	WCC 129 – Latin Dance (Cha Cha)
WCC128/1 - Seni Sulaman & Manik Labuci (Embroidery & Beads Sequins Art)	
WCC 130/1 - Seni Fotografi SLR Digital (Digital SLR Photography Art)	
WCC/131/1 - Seni Suntingan Fotografi (Editing Photography Art)	
WCC132/1 – Seni Seramik (The Art of Ceramics)	

(ii) WSU 101/2 - Sustainability: Issues, Challenges & Prospect (2 units)

Course Synopsis

This course introduces and exposes students to the concepts of sustainable development. The course is aimed at ensuring that the ability of the next generation to fulfil their needs in the future will not be jeopardized, especially in an era of globalization that is filled with challenges and rapid advances in information technology. Sustainable development by definition, involves efforts to maintain the balance among the three important aspects, i.e. competitive economy, balanced ecosystem and social integration. For the economic aspect, it touches on the issues of development, economic growth, economic challenges of population, agriculture and industrial sector contributions, finance sector, and also information and technology. Environmental sustainability, on the other hand, focuses on forest and environmental management, marine resource management, eco-tourism, environmental degradation, natural phenomena, global warming, and also ethics in natural resource management. The social integration aspect emphasizes the role of the communities in practising sustainable development in daily life with health management, security (climate change, epidemics, crime and terrorism) and socio-economic network. Sustainable development models and case studies will be discussed too.

(iii) HTV201/2 - Teknik Berfikir (Thinking Techniques)

(iv) Other options/ skills courses as recommended or required by the respective Schools (if any)

(v) English Language Courses

The following courses may be taken as university courses to fulfil the compulsory English Language requirements (for Band 5 and Band 6 in MUET) or as skills/option courses:

No	Code/Unit	Course Title
1.	LHP451/2	Effective Reading
2.	LHP452/2	Business Writing
3.	LHP453/2	Creative Writing
4.	LHP454/2	Academic Writing

No	Code/Unit	Course Title
5.	LHP455/2	English Pronunciation Skills
6.	LHP456/2	Spoken English
7.	LHP457/4	Speech Writing and Public Speaking
8.	LHP458/2	English for Translation *(Offered only in Semester II)*
9.	LHP459/2	English for Interpretation *(Offered only in Semester I)*

(vi) Foreign Language Courses

The foreign language courses offered by the School of Languages, Literacies and Translation can be taken by students as an option or compulsory courses to fulfil the number of units required for graduation. Students are not allowed to register for more than one foreign language course per semester. They must complete at least two levels of a foreign language course before they are allowed to register for another foreign language course. However, students are not required to complete all four levels of one particular foreign language course. The foreign language courses offered are as follows:

Arabic	Chinese	Japanese	German	Spanish
LAA100/2	LAC100/2	LAJ100/2	LAG100/2	LAE100/2
LAA200/2	LAC200/2	LAJ200/2	LAG200/2	LAE200/2
LAA300/2	LAC300/2	LAJ300/2	LAG300/2	LAE300/2
LAA400/2	LAC400/2	LAJ400/2	LAG400/2	LAE400/2

French	Thai	Tamil	Korean
LAP100/2	LAS100/2	LAT100/2	LAK100/2
LAP200/2	LAS200/2	LAT200/2	LAK200/2
LAP300/2	LAS300/2	LAT300/2	LAK300/2
LAP400/2	LAS400/2		

4.0 INTRODUCTION

4.1 School of Chemical Engineering

The School of Chemical Engineering was established on the 1st May 1992 under the Sixth Malaysia Plan. The establishment is parallel with the aspiration of the Malaysian Government to build the country as a progressive industrial nation. Aligned with the aim, the School of Chemical Engineering has put all effort and commitment to train selected students to become qualified, outstanding, highly trained and resourceful graduates.

4.2 Philosophy and Objectives

4.2.1 Mission of the School of Chemical Engineering

The Mission of the School of Chemical Engineering, Universiti Sains Malaysia is to provide high-quality education and research and to produce well-trained chemical engineering graduates who are critical thinkers, problem solvers, innovators, entrepreneurs, leaders and life-long learners in a global society to meet the technological and societal expectations.

4.2.2 Bachelor of Chemical Engineering Programme

The School of Chemical Engineering, Universiti Sains Malaysia offers Bachelor of Engineering in Chemical Engineering degree programme with honours. Beginning Academic Session 2000/2001, the students are taught under the 4 year programme. The undergraduate program has been accredited by the Engineering Accredition Council (EAC), Board of Engineers Malaysia. The undergraduate programme is also recognized internationally as it has been accredited by the Institution of Chemical Engineers (IChemE), United Kingdom as satisfying the full Master of Engineering (MEng) academic requirement for registration as a Chartered Chemical Engineer.

The academic programme is capable in shaping students into conversant Chemical Engineers, covering every important aspects of Chemical Engineering. Accordingly, undergraduate students at the School of Chemical Engineering are given the opportunity to choose into some advanced chemical engineering areas during the third and final years of their studies. These courses are categorised into 3 main areas:

(a) Process Control

This area leads undergraduates into designing, handling and maintaining control systems and instrumentations in the chemical plants. The curriculum covers

knowledge of basic chemical engineering, electrical and electronics besides instrumentations used.

(b) Bioprocess Engineering and Environmental Processes

Bioprocess Engineering is about the application of chemical engineering principles in biological processes that includes industries using microorganisms such as those found in the fermentation sector and the production of chemicals for the food and pharmaceutical industries. Bioprocess Engineering is also about solving environmental pollution problems through biological methods. Environmental Processes meanwhile is a wide field that deals with the application of the physical sciences and living organism systems so as to produce processes which are safer and more efficient. Emphasis is given on the design, operation and maintenance of processes that are related to value-added production, pollution control, waste treatment and the disposal of toxic and radioactive materials.

(c) Separation Processes and Catalysis

The field of Separation Processes exposes the students to the major types of processes that are commonly used in the industry to separate desired or undesired components from homogeneous or heterogeneous mixtures. Solid, liquid or gas phases and supercritical fluids that constitute the mixtures are parts of the curriculum. Students will also be exposed to process work principles, types of equipment used, process characteristics and control, design and other supporting requirements so as to enable them to successfully operate these processes.

The field of catalysis involves the study and research of catalysts production, testing and characterization that will eventually be used for specific applications in industrial processes. Studies on catalyst applications will include the roles of catalysts in the production and enhancement of fuels, the production of specialty chemicals and drugs and the preservation of the environment. Students will also be exposed to the important aspects of operating catalytic processes in the industry.

4.2.3 General Educational Goals and Objectives

The mission of the School of Chemical Engineering, Universiti Sains Malaysia is to provide education and research that are of high quality so as to produce chemical engineering graduates who would be well-trained in chemical engineering knowledge in addition to developing their personal potential, abilities and skills in critical and innovative thinking, problem solving and life-long learning. The School aims to produce graduates who would become leaders and/or entrepreneurs in the current global society and be able to meet technological and societal expectations.

The main goal of the Bachelor of Chemical Engineering degree programme is to produce highly qualified and professional Chemical Engineering graduates who will be valuable assets to the industrial, governmental or statutory bodies. Moreover, the programme objectives of the Bachelor of Chemical Engineering degree programme are as follows:

(a) Employable graduates with the knowledge and competency in chemical engineering.

(b) Graduates having good leadership and soft skills with the right attitudes and ethics.

(c) Innovative graduates with problem solving skills for sustainability.

(d) Graduates who possess interest in research and lifelong learning.

To achieve and accelerate the above vision, the School has been awarding the Dean's List for students who have achieved a Semester Grade Point Average (GPA) of 3.50 and above beginning from the 1997/98 Semester II Academic Session. The School has no restrictions on the number of recipients for this award.

4.2.4 Programme Outcomes

Beginning from the 2006/2007 Academic Session, the Outcome-Based Education philosophy has been incorporated into the Chemical Engineering Bachelor's Degree Programme curriculum in Universiti Sains Malaysia. Thus, in order to attain the educational objectives of the programme and as fulfilling the requirements of the Engineering Accreditation Council, the School of Chemical Engineering has formulated eleven programme outcomes that encompasses the skills, knowledge and behaviours that would be acquired by the students when they graduate from the programme. The formulated programme outcomes are:

1) Ability to apply knowledge of mathematics, science and chemical engineering fundamentals to solve complex chemical engineering problems

2) Ability to analyse complex engineering problems and formulate the solution using literature

3) Ability to solve complex chemical engineering problems with consideration for public, health, safety, cultural, societal and environmental issues

4) Ability to conduct investigation into complex problems using research-based knowledge and research methods in the field of chemical engineering

5) Ability to design and evaluate the performance of complex chemical engineering activities using modern engineering and IT tools

6) Ability to apply engineering and management principles in engineering projects

7) Ability to assess the environmental and societal impact due to professional engineering solutions and demonstrate the need for sustainable development

8) Ability to apply contextual knowledge in assessing societal, health, safety, legal and cultural issues and apply ethical principles relevant to engineering practice

9) Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice

10) Ability to communicate effectively on complex engineering activities with fellow engineers and the society at large

11) Ability to function effectively in multidisciplinary settings, as an individual or group member with the capacity to be a leader

12) Ability to recognize the need to undertake lifelong learning and acquire the capacity to do so in the broadest context of technological change

4.2.5 Applications of Soft Skills

The current necessity of strong skills, which comprises of critical thinking, problem solving skills, leadership, positive values, team work, language proficiency, and communication skills in the society and industry are highly demanding. The issue of soft skills acquisition is critical as the future industry leader in Malaysia is expected to be equipped with technical and leadership skills in order to be at the top position. Moreover, poor level of communication skills has always been an obstacle for engineers with solid technical background.

Realizing the importance of soft skills, all teaching activities beginning from the 2005 intake are in English. In addition, students are required to take two English Language courses, with emphasis on four communication skill areas: listening, speaking, reading, and writing. Meanwhile, apart from English Language courses, there are other language modules offered to students at USM's Engineering Campus.

The Engineering Campus Language Centre offers language modules such as Arabic, French, Japanese, Mandarin, and Malay language from the beginner's level up to the advanced level.

The social aspect is fulfilled through four modules: Engineers in Society (EUP 222), Islamic Civilization and Asian Civilization (HTU 223), Entrepreneurship (WUS 101) and Ethnic Relations (SHE 101). In addition, students were also trained to function on transdisciplinary teams by integrating knowledge from Engineering Materials (EBB 113), Electrical Technology (EEU 104), and Engineering Mechanics (EMM 101) into their chemical engineering discipline.

4.3 School Principal Officers

Professor Dr. Azlina Harun @ Kamaruddin
Dean

Associate Professor
Dr. Ir. Zainal Ahmad
Deputy Dean
[Academic, Students and Alumni]

Professor
Dr. Ahmad Zuhairi Abdullah
Deputy Dean
[Research, Postgraduates and Networking]

Associate Professor
Dr. Mohamad Hekarl Uzir
Manager
[Talent Empowerment and Creativity]

Associate Professor
Dr. Tan Soon Huat
Manager
[Infastructure]

Dr. Khairiah Abd Karim
Manager
[Quality]

Ms. Noroslinda Hussain
[Principal Assistant Registrar]

Mr. Mohd. Kamil Ashar
[Assistant Registrar]

4.4 School Staff List

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4.5 External Examiner

Jackie Y.Ying, Professor	Institute of Bioengineering and Nanotechnology 31 Biopolis Way, The Nanos, Singapore 138669

4.6 Industry/Community Advisory Panel - ICAP

Nur Iskandar A. Samad, Datuk	Venture Lead, PETRONAS Refinery and Petrochemical Integrated Development (RAPID) Project, Level 62 Vista Tower, The Intermark, 348 Jalan Tun Razak, 50400 Kuala Lumpur
Azman Ismail, Datuk	Managing Director, PLUS Malaysia Berhad (923639-A) Menara Korporat, Persada PLUS Persimpangan Bertingkat Subang, KM15 Lebuhraya Baru Lembah Klang 47301 Petaling Jaya Selangor Darul Ehsan Malaysia
Paul Ellis, Mr.	Managing Director, Schaefer Kalk (Malaysia), Lot. 14, 1st Floor, Jalan 1/137C, Bedford Business Park, Batu 5, Off Jalan Kelang Lama C, 58000 Kuala Lumpur
Khalidah Ambiah, Mrs.	Head of Technical Services, Petronas Chemical Fertilizer Kedah Sdn. Bhd., KM 3, Jalan Jeniang, P.O. Box 22, 08300 Gurun, Kedah
Muslisham Omar, Mr.	Head of Operations Improvement and Optimization, Downstream Operations Division, Level 73, Tower 2, Petronas Twin Towers, Kuala Lumpur City Centre (KLCC), 50088 Kuala Lumpur

4.7 Laboratory Facilities

The School of Chemical Engineering is well-equipped with complete and sophisticated facilities for teaching and research purposes. The available facilities include; laboratories with modern and sophisticated equipments. Those laboratories are as follows:

1. Process Control Laboratory
2. Biochemistry Laboratory
3. Petroleum and Gas Laboratory
4. Unit Operation Laboratory
5. Chemistry Laboratory
6. Computer Laboratory
7. Environmental Control Laboratory
8. Analytical Laboratory

Besides teaching laboratories, the school has also provided special laboratories for higher degree students to carry out their research work as follows: -

1. Research Laboratory I
2. Research Laboratory II
3. Research Laboratory III
4. Research Laboratory IV
5. Research Laboratory V
6. Research Laboratory VI
7. Research Laboratory VII
8. Research Laboratory VIII
9. Research Laboratory IX

4.8 Job Opportunities

Holders of Bachelor of Engineering (Chemical Engineering) degree have a bright future in job sourcing ranging from technological to management aspects in various industries. Some job scopes of various designations are as follows:-

1. Project Engineer

   Some roles of project engineers are as follows:-

   - Evaluate and develop suitable technology
   - Technology transfer
   - Budget and finance

2. Process/Production and Technical Engineer

For this job, graduates should be trained in:

- Process and equipment
- Mass & energy balance
- Use of chemicals and catalyst
- Environmental issues & effluent flow

Some basic tasks in this designation are as follows:-

- Study of existing methods and manual
- Indicate and suggest methods to improve quality
- Cost reduction
- Increase safety measures
- Design alternative process design
- Carry out modification

3. Marketing and sales

For this job, graduates are responsible in:

- Planning marketing strategies
- Creating and establishing marketing networks
- Implementing sales strategies
- Sensitive to market needs, competitors and achieving sales target

4. Public sector

Graduates interested in public sector may serve as an academician in universities and to be involved in teaching and research & development. Through research, they can open up new avenues in chemical engineering through new findings, discovering new technology or products. Discoveries are achievable through:

- Modification of existing plant
- Innovation of existing plant
- Designing/planning of new units

4.9 Post Graduate Studies and Research Programme

The School also offers Graduate Studies Programme through research mode in various engineering fields for Masters in Science (M.Sc.) or Doctor of Philosophy (PhD). Both courses are available as fulltime and part time basis in the research fields as follows:

- Pollution Control and Waste Treatment (air and water)
- Catalysts Characterization and Testing
- Process Modeling, Simulation and Optimization of Industrial Reactors
- Membrane Processes
- Zeolite Synthesis
- Immobilized Enzyme Reactors
- Biotechnology
- Process Development
- Plant Safety
- Process Control and Automation
- Environmental Protection
- Natural Gas and Petroleum Processing and Operations

4.10.1. CURRICULUM STRUCTURE - BACHELOR OF ENGINEERING (HONOURS) (CHEMICAL ENGINEERING)

TYPE	CATEGORY	100 LEVEL				200 LEVEL				300 LEVEL				400 LEVEL			
		SEMESTER I	MID SEMESTER BREAK	SEMESTER 2	LONG BREAK	SEMESTER I	MID SEMESTER BREAK	SEMESTER 2	LONG BREAK	SEMESTER I	MID SEMESTER BREAK	SEMESTER 2	EKC 395/5 INDUSTRAIL TRAINING 10 WKS	SEMESTER I	MID SEMESTER BREAK	SEMESTER 2	
CORE	ENGINEERING CORE	EMM 101/3 Engineering Mechanics		EEU 104/3 Electrical Technology		EKC 212/4 Fluid Flow for Chemical Engineering		EKC 216/3 Process Heat Transfer		EKC 314/3 Transport Phenomena		EKC 316/4 Separation Processes		EKC 451/4 Process Design and Analysis		EKC 453/4 Plant Design and Economics	
		EML 101/2 Engineering Practice		EUM 114/3 Advanced Engineering Calculus		EKC 214/3 Energy Balance		EKC 222/3 Chemical Engineering Thermodynamics		EKC 336/3 Chemical Reaction Engineering		EKC 338/4 Reactor Design and Analysis		EKC 499/2 Final Year Project		EKC 499/4 Final Year Project	
		EUM 113/3 Engineering Calculus		EKC 108/4 Physical and Analytical Chemistry		EKC 217/3 Mass Transfer		EUP 222/3 Engineers In Society		EKC 361/4 Process Dynamics and Control		EKC 367/3 Plant Safety					
		EBB 113/3 Engineering Materials		EKC 111/3 Mass Balance		EKC 246/3 Computer Programming and Applications		EKC 245/3 Mathematical Methods for Chemical Engineering		EKC378/3 Environmental Engineering and Management							
		EKC 107/3 Organic Chemistry		EKC 109/2 Introduction to Project Management		EKC 271/3 Biotechnology for Engineers											
		EKC 157/2 Chemical Engineering Drawing															
	LAB							EKC 291/2 Chemical Engineering Laboratory I				EKC 394/2 Chemical Engineering Laboratory II		EKC 493/2 Chemical Engineering Laboratory III			
		16		15		16		14		13		13	5	8		8	**108**
UNIVERSITY REQUIREMENTS				LKM 400 Malay Language (2 Units)		LPS 300 (2 Units) English Language for Academic		HTU 223 (2 Units) Islamic Civilization and Asian Civilization		LSP 404 (2 Units) English Language for Technical And Engineers		Co-curriculum/ Options (3 Units)		Co-curriculum/ Options		Co-curriculum/ Options	
				WUS 101 (2 Units) Entrepreneurship				SHE 101 (2 Units) Ethnic Relations									**15**
ELECTIVE												EKC 376/3 Downstream Processing of Biochemical and Pharmaceutical Products		EKC 475/3 Wastewater Treatment Engineering		EKC 462/3 Advanced Control Systems for Industrial Processes	
												EKC 377/3 Renewable and Alternative Energies		EKC 483/3 Petroleum and Gas Processing Engineering		EKC 463/3 Advanced Process Safety Engineering	
																	12
OVERALL TOTAL FOR CONFERRAL OF DEGREE																	**135**

Note: University Requirements 15 units
Electives 12 units
EKC 499 – 2 semester workload: **Semester I : 2 units**
Semester II: 4 units

***Courses offered may be subject to changes**

4.10.2 CURRICULUM BY SEMESTER

LEVEL 100

Courses Offered		Units		
		Value	**Lecture**	**Lab**
Semester I				
EMM 101	Engineering Mechanics	3	3	0
EML 101	Engineering Practice	2	0	4
EUM 113	Engineering Calculus	3	3	0
EBB 113	Engineering Materials	3	3	0
EKC 107	Organic Chemistry	3	2	2
EKC 157	Chemical Engineering Drawing	2	1	2
		16	**12**	**8**
MID-SEMESTER BREAK				
Semester II				
EEU 104	Electrical Technology	3	3	0
EKC 108	Physical and Analytical Chemistry	4	3	2
EKC 111	Mass Balance	3	3	0
EUM 114	Advance Engineering Calculus	3	3	0
EKC 109	Introduction to Project Management	2	2	0
		15	**14**	**2**
SEMESTER BREAK (11 weeks)				

LEVEL 200

Courses Offered		Units		
		Value	**Lecture**	**Lab**
Semester I				
EKC 212	Fluid Flow for Chemical Engineering	4	4	0
EKC 214	Energy Balance	3	3	0
EKC 217	Mass Transfer	3	3	
EKC 246	Computer Programming and Applications	3	2	2
EKC 271	Biotechnology for Engineers	3	3	0
		17	**15**	**2**
MID-SEMESTER BREAK				

Semester II				
EKC 216	Process Heat Transfer	3	3	0
EKC 222	Chemical Engineering Thermodynamics	3	3	0
EUP 222	Engineers in Society	3	3	0
EKC 245	Mathematical Methods for Chemical Engineering	3	3	0
EKC 291	Chemical Engineering Laboratory I	2	0	4
		14	**12**	**4**
SEMESTER BREAK (11 weeks)				

LEVEL 300

Courses Offered		**Units**		
		Value	**Lecture**	**Lab**
Semester I				
EKC 314	Transport Phenomena	3	3	0
EKC 336	Chemical Reaction Engineering	3	3	0
EKC 361	Process Dynamics and Control	4	4	0
EKC 378	Environmental Engineering and Management	3	3	0
		13	**13**	**0**
MID-SEMESTER BREAK				
Semester II				
EKC 316	Separation Process	4	4	0
EKC 338	Reactor Design and Analysis	4	4	0
EKC 367	Plant Safety	3	3	0
EKC 394	Chemical Engineering Laboratory II	2	0	4
		13	**11**	**4**
ELECTIVES (Choose One)				
EKC 376	Downstream Processing of Biochemical and Pharmaceutical Products	3	3	0
EKC 377	Renewable and Alternative Energies	3	3	0
		3	**3**	**0**

SEMESTER BREAK (11 weeks) – EKC 395/5 Industrial Training (10 weeks)

LEVEL 400

Courses Offered		Units		
		Value	**Lecture**	**Lab**
Semester I				
EKC 451	Process Design and Analysis	4	3	2
EKC 493	Chemical Engineering Laboratory III	2	0	4
EKC 499	Final Year Project	2	1	1
		8	**4**	**7**
ELECTIVES				
EKC 475	Wastewater Treatment Engineering	3	3	0
EKC 483	Petroleum and Gas Processing Engineering	3	3	0
		6	**6**	**0**
MID-SEMESTER BREAK				
Semester II				
EKC 453	Plant Design and Economics	4	3	2
EKC 499	Final Year Project	4	0	4
		8	**3**	**6**
ELECTIVES				
EKC 462	Advanced Control Systems for Industrial Processes	3	3	0
EKC 463	Advanced Process Safety Engineering	3	3	0
		3	**3**	**0**

4.10.3 COURSE-PROGRAMME OUTCOME MATRIX

Level 100

Code	Course	Emphasis to the Programme Outcomes											
		Ability to apply knowledge of mathematics, science and chemical engineering fundamentals to solve complex chemical engineering problems	Ability to analyse complex engineering problems and formulate the solution using literature	Ability to solve complex chemical engineering problems with consideration for public, health, safety, cultural, societal and environmental issues	Ability to conduct investigation into complex problems using research-based knowledge and research methods in the field of chemical engineering	Ability to design and evaluate the performance of complex chemical engineering activities using modern engineering and IT tools	Ability to apply engineering and management principles in engineering projects	Ability to assess the environmental and societal impact due to professional engineering solutions and demonstrate the need for sustainable development	Ability to apply contextual knowledge in assessing societal, health, safety, legal and cultural issues	Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice	Ability to communicate effectively on complex engineering activities with fellow engineers and the society at large	Ability to function effectively in multidisciplinary settings, as an individual or group member with the capacity to be a leader	Ability to recognize the need to undertake lifelong learning and acquire the capacity to do so in the broadest context of technological change
EBB 113	Engineering Materials*	HI		LO	LO	LO	MED	LO	LO	LO		MED	
EEU 104	Electrical Technology	MED	LO	HI	LO	MED		LO	MED	MED		LO	HI
EMM 101	Engineering Mechanics*		HI						MED	MED			

EML 101	Engineering Practise*					LO			HI	HI			
EKC 107	Organic Chemistry *	LO	MED	LO	MED							LO	LO
EKC 108	Physical and Analytical Chemistry	MED	HI		MED						MED	MED	
EKC 109	Introduction To Project Management	MED	MED	MED		MED	HI		MED	MED	HI	MED	LO
EKC 111	Mass Balance	HI	MED			MED							LO
EKC 157	Chemical Engineering Drawing *	LO		LO		MED							
EUM 113	Engineering Calculus										MED		HI
EUM 114	Advanced Engineering Calculus										MED		HI

Key:

	NO EMPHASIS
LO	SOME EMPHASIS
MED	MODERATE EMPHASIS
HI	STRONG EMPHSIS
*	COURSE IN FIRST SEMESTER

4.10.3 COURSE-PROGRAMME OUTCOME MATRIX

Level 200

Code	Course	Emphasis to the Programme Outcomes											
		Ability to apply knowledge of mathematics, science and chemical engineering fundamentals to solve complex chemical engineering problems	Ability to analyse complex engineering problems and formulate the solution using literature	Ability to solve complex chemical engineering problems with consideration for public, health, safety, cultural, societal and environmental issues	Ability to conduct investigation into complex problems using research-based knowledge and research methods in the field of chemical engineering	Ability to design and evaluate the performance of complex chemical engineering activities using modern engineering and IT tools	Ability to apply engineering and management principles in engineering projects	Ability to assess the environmental and societal impact due to professional engineering solutions and demonstrate the need for sustainable development	Ability to apply contextual knowledge in assessing societal, health, safety, legal and cultural issues	Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice	Ability to communicate effectively on complex engineering activities with fellow engineers and the society at large	Ability to function effectively in multidisciplinary settings, as an individual or group member with the capacity to be a leader	Ability to recognize the need to undertake lifelong learning and acquire the capacity to do so in the broadest context of technological change
EKC 212	Fluid Flows for Chemical Engineering *	HI	HI			MED					HI		

EKC 216	Process Heat Transfer	HI	HI	MED	LO	MED					MED		
EKC 214	Energy Balance *	HI	HI			MED							
EKC 217	Mass Transfer *	HI	HI									HI	
EKC 222	Chemical Engineering Thermodynamics	HI	HI			MED					LO		
EKC 245	Mathematical Methods for Chemical Engineering	HI	HI	HI		MED						MED	
EKC 246	Computer Programming and Applications *	HI	HI			MED					MED	MED	
EKC 271	Biotechnology for Engineers *	LO	MED	MED							HI	MED	LO
EKC 291	Chemical Engineering Laboratory I		HI	HI	HI	LO					HI	HI	HI
EUP 222	Engineers In Society	LO	LO	HI	LO	LO	MED	HI	HI	HI	HI	MED	LO

Key:

	NO EMPHASIS
LO	SOME EMPHASIS
MED	MODERATE EMPHASIS
HI	STRONG EMPHSIS
*	COURSE IN FIRST SEMESTER

4.10.3 COURSE-PROGRAMME OUTCOME MATRIX

Level 300

Code	Course	Emphasis to the Programme Outcomes											
		Ability to apply knowledge of mathematics, science and chemical engineering fundamentals to solve complex chemical engineering problems	Ability to analyse complex engineering problems and formulate the solution using literature	Ability to solve complex chemical engineering problems with consideration for public, health, safety, cultural, societal and environmental issues	Ability to conduct investigation into complex problems using research-based knowledge and research methods in the field of chemical engineering	Ability to design and evaluate the performance of complex chemical engineering activities using modern engineering and IT tools	Ability to apply engineering and management principles in engineering projects	Ability to assess the environmental and societal impact due to professional engineering solutions and demonstrate the need for sustainable development	Ability to apply contextual knowledge in assessing societal, health, safety, legal and cultural issues	Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice	Ability to communicate effectively on complex engineering activities with fellow engineers and the society at large	Ability to function effectively in multidisciplinary settings, as an individual or group member with the capacity to be a leader	Ability to recognize the need to undertake lifelong learning and acquire the capacity to do so in the broadest context of technological change
EKC 316	Separation Process	HI	MED	MED		LO					HI	HI	MED
EKC 314	Transport Phenomena *	HI	LO		LO								

EKC 336	Chemical Reaction Engineering *	HI	LO	LO		MED						MED	
EKC 337	Reactor Design and Analysis	HI	HI	HI		HI					HI		
EKC 361	Process Dynamics and Control *	HI	HI		HI							HI	
EKC 367	Plant Safety	HI	MED	MED		MED		HI	MED	MED		MED	MED
EKC 376	Downstream Processing of Biochemical and Pharmaceutical Products	HI	HI	MED							MED	MED	MED
EKC 377	Renewable and Alternative Energies	HI	HI	MED		MED							
EKC 378	Environmental Engineering and Management *	HI	MED	MED			LO	HI	HI	HI	HI	HI	LO
EKC 394	Chemical Engineering Laboratory II		HI	HI	HI	LO					HI	HI	HI
EKC 395	Industrial Training	HI	HI	HI		HI		HI	HI	HI		HI	

Key:

	NO EMPHASIS
LO	SOME EMPHASIS
MED	MODERATE EMPHASIS
HI	STRONG EMPHSIS
*	COURSE IN FIRST SEMESTER

4.10.3 COURSE-PROGRAMME OUTCOME MATRIX

Level 400

Code	Course	Emphasis to the Programme Outcomes											
		Ability to apply knowledge of mathematics, science and chemical engineering fundamentals to solve complex chemical engineering problems	Ability to analyse complex engineering problems and formulate the solution using literature	Ability to solve complex chemical engineering problems with consideration for public, health, safety, cultural, societal and environmental issues	Ability to conduct investigation into complex problems using research-based knowledge and research methods in the field of chemical engineering	Ability to design and evaluate the performance of complex chemical engineering activities using modern engineering and IT tools	Ability to apply engineering and management principles in engineering projects	Ability to assess the environmental and societal impact due to professional engineering solutions and demonstrate the need for sustainable development	Ability to apply contextual knowledge in assessing societal, health, safety, legal and cultural issues	Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice	Ability to communicate effectively on complex engineering activities with fellow engineers and the society at large	Ability to function effectively in multidisciplinary settings, as an individual or group member with the capacity to be a leader	Ability to recognize the need to undertake lifelong learning and acquire the capacity to do so in the broadest context of technological change
EKC 451	Process Design and Analysis *	HI	HI	HI		HI	HI	HI	MED	MED	HI	HI	
EKC 453	Plant Design and Economics	HI	HI	HI		HI	HI	HI	HI	HI	HI	HI	

EKC 462	Advanced Control System for Industrial Processes	HI	MED			MED					HI	MED	MED
EKC 463	Advanced Process Safety Engineering	HI	HI	HI							HI		MED
EKC 475	Wastewater Treatment Engineering *	HI	HI	HI				HI	LO	LO			HI
EKC 483	Petroleum and Gas Processing Engineering *	MED	MED	LO				HI	LO	LO	HI	MED	HI
EKC 493	Chemical Engineering Laboratory III*		HI	HI	HI	LO					HI	HI	HI
EKC 499	Final Year Project	HI		HI		HI		HI	HI	HI	HI	HI	HI

Key:

	NO EMPHASIS
LO	SOME EMPHASIS
MED	MODERATE EMPHASIS
HI	STRONG EMPHSIS
*	COURSE IN FIRST SEMESTER

4.10.4 COURSE DESCRIPTION

EMM 101/3 Engineering Mechanics

Objective: To provide students with the fundamental concepts and principles of rigid bodies in statics and dynamics equilibrium.

Synopsis: This course is an introduction to the mechanics of rigid bodies. It is divided into two areas: Statics and Dynamics. In Statics, the student will learn the fundamental concepts and principles of rigid bodies in static equilibrium. In Dynamics, the student will learn the fundamental concepts and principles of the accelerated motion of a body (a particle). Consideration is given on the fundamental of mechanics and structure analysis, including concepts of free body diagram as well as force, moment, couples, kinematic of motion, momentum, impulse, conservation of energy and equilibrium analyses in two and three dimensions.

Course Outcomes:

- Able to identify and resolve force magnitudes and vectors into components.
- Able to describe and draw the free-body diagram and to solve the problems using the equations of equilibrium.
- Able to define the system of forces and moments and calculate the resultants of force using the concept of equilibrium system.
- Able to identify and calculate the centroid, centre of gravity and area moment of inertia.
- Able to describe the motion of a particle in terms of kinematics.
- Able to apply equation of motion in solving dynamics problems.
- Able to apply the principles of energy and momentum in solving dynamics problems.

References:

1. Hibbeler, R.C., Engineering Mechanics: Statics and Dynamics, 12th ed., SI Units, Prentice Hall, 2009.
2. Meriam, J.L. and Kraige, L.G., Engineering Mechanics: Statics and Dynamics, 4th ed., Wiley, 1998.
3. Beer, F.P. and Johnston Jr.E.R., Vector Mechanics for Engineers: Statics and Dynamics, 7th ed., SI Units, Mc Graw Hill, 2004.

(Offered by School of Mechanical Engineering)

EML 101/2 Engineering Practice

Objective: To provide the exposure and basic knowledge of hands-on engineering practices that includes the academic aspects as well as practical trainings in learning and teaching of common engineering workshop works and also to optimize the use of available resources in the laboratory

Synopsis: Trainings are based on theoretical and practical concepts which consists of manufacturing process; computer numerical control (CNC), lathe, mill and thread machining, joint process, arc welding, gas welding and MIG welding, metrology measurement, electric and electronic circuits, and safety practice in laboratory and workshop.

Course Outcomes:

- Able to comply with the workshop procedures and safety regulation.
- Able to identify and to use common engineering tools in proper and safe manners.
- Able to produce engineering work-piece using the correct tools and equipment within the time allocated.
- Able to carry out accurate engineering measurement and label the dimensions and tolerance.
- Able to select the optimum tools, equipment and processes in producing the work-piece.

References:

1. Child, J.J., An Introduction to CNC Machining, Cassell Computing, 1984.
2. Kalpakjan, S., Manufacturing Engineering and Technology, 3rd ed., Addison Wesley, 1995.
3. Ibrahim Che Muda dan Ramudaram, N., Teknologi Bengkel Mesin, 1995.
4. Ahmad Baharuddin Abdullah, Modul Kerja Amalan Kejuruteraan (PPKM), 2005.

(Offered by School of Mechanical Engineering)

EUM 113/3 Engineering Calculus

Objective: This course reviews the concept of one and multivariable calculus and covers the concept of ordinary differential equation. This course will provide students with a variety of engineering examples and applications based on the above topics.

Synopsis:

Calculus of One Variable

Concept of Function: domain and range, limit and continuity, L'Hopital Rule.
Differentiation: mean theorem concept, techniques of solutions and applications.
Integration: Riemann sum concept, techniques of solutions and applications.
Solution of Numerical Method
Newton Raphson, Simpson

Calculus of Multivariable

Multivariable Function: scalar and vector, operator with vector function, limits and continuity.
Partial Differentiation: chain rule, derivatives differential and vector slope, maximum and minimum values, Lagrange multiplier.
Multiple Integration: Double integration and its application, triple integration and its applications, change of variables in multiple integration.

Ordinary Differential Equations

Solution of First Order ODE: separation of variables, linear, Bernoulli, exact, non exact, homogenous, non homogenous.
Solution of Second Order ODE:
Homogenous linear with constant coefficients
Non Homogenous linear with constant coefficients: method of undetermined coefficient, operator D, variation of parameter.
Euler Cauchy equation.
Solution of ODE using: Laplace Transform and numerical method (Euler)

Course Outcomes:

- able to define the concept and solve the problem of one and multivariable calculus.
- able to define the concept of ODE and recognize different methods for solving ODE.
- able to use the analytical and numerical methods to solve ODE problems.
- able to apply the above concepts for solving engineering problems.

References:

1. Glyn J., (2010).Modern Engineering Mathematics, 4th Edition Pearson
2. Glyn, J., (2010).Advanced Modern Engineering Mathematics, 4th Edition .Pearson
3. Silvanum P.Thompson, Martin Gardner (2008). Calculas Made Easy, Enlarge Edition. Johnston Press
4. J.N.Sharma. (2007). Numerical Method for Engineers, 2nd Edition. Alpha Science
5. Smith R.T. and Minton, R., (2008), Calculus, 3rd Edition. Mc Graw Hill.

(Offered by School of Electric and Electronics Engineering)

EBB 113/3 Engineering Materials

Objective: To introduce the basic of engineering materials and the relationship between the structure and properties of materials.

Synopsis: The course is an introductory course on engineering materials which is divided into three main parts. The first part includes the classifications of materials that determine their applicability, the structure of the materials explained by the quantum-mechanical principle that relates electrons to energies, bonding scheme of different materials, the structure of crystalline solids and introduction to imperfection in solids. The second part covers the mechanical characteristics of materials for service use and methods of assessing the mechanical characteristics of materials. The second part also includes the behaviour of material in thermal equilibrium (free energy concept, phase transformation and examples of phase diagrams), diffusion mechanisms and usual causes of failure in a given material. The third part is on application and processing of specific material (metals, ceramics and polymer). Introduction of electrical, magnetic and optical properties of materials is also presented in the course. In general, this introductory materials science and engineering course deals with the different material types (i.e., metals, ceramics, polymers, composites), as well as the various kinds of properties exhibited by these materials (i.e., mechanical, electrical, magnetic, etc.) which intended to equip the students with necessary knowledge on material science and engineering.

Course Outcomes:

- Able to list the primary classifications of solid materials and to cite the distinctive chemical features of each class.
- Able to outline the criteria that is important in the materials selection process.
- Able to correlate the structures of a material with its behaviour and performance.
- Able to explain methods of assessing mechanical characteristics of materials.
- Able to describe processing techniques of a material for typical applications

References:

1. Materials Science and Engineering an Introduction, W.D. Callister, Jr., 6th edition, Wiley, 2003.
2. The Science and Engineering of Materials, Donald R. Askeland, Pradeep P. Phulé, Chapman & Hall, fourth edition, Thomson Leaning, 2003, USA.
3. Foundations of Materials Science and Engineering, 3rd Edition, William F. Smith, William Smith, McGraw Hill, 2004, New York.
4. Introduction to Materials Science for Engineers, 5th Edition, James F. Shackelford, Prentice Hall, 2000, New Jersey.

(Offered by School of Materials and Mineral Resources Engineering)

EKC 107/3 Organic Chemistry

Objective: Students will acquire the ability to correlate the concepts of synthetic chemistry in industrial processes.

Synopsis: This course deals with important organic chemical processes and industrial chemical reactions. Typical reactions like hydrogenation, esterification/transesterification, oxidation and polymerization will be described with emphasis on compounds and reactions of industrial importance. Some experiments will be carried out which focus on synthesis of basic organic chemical products to reinforce the theory.

Course Outcomes:

- Name the IUPAC nomenclatures and common names of organic compounds and also to relate the structure of the organic compounds to the physical properties.
- Formulate a chemical reaction equation for given reactants, products or reagents and propose its mechanism using the curved arrow and structures

- Apply the concept of synthetic chemistry in process industries.
- Conduct experiments based on the theoretical concepts.

References:

1. Mc Murry J., 'Organic Chemistry' 7th Edition, Brooks Cole, 2008
2. Austin G.T., 'Shreve's Chemical Process Industries', 5th Edition, Mc Graw-Hill, 1984.
3. Weissermel K., Hans-Jurgen Arpe, 'Industrial Organic Chemistry', 4th Edition, Wiley, 2002.

EKC 157/2 Chemical Engineering Drawing

Objective: At the end of this course, the student will be exposed to the basic concepts of standard Engineering Drawing and the application of conventional signs, symbols, lettering, geometry, instrument needed, types of orthographic and isometric presentation including piping system. It also exposes students to application of AUTOCAD and PROCEDE software in engineering process drawing.

Synopsis: The student will be exposed to the basic concepts of standard Engineering Drawing and the application of conventional signs, symbols, lettering, geometry, instrument needed, types of orthographic and isometric presentation including piping system. It also exposes students to application of AUTOCAD and PROCEDE software in engineering process drawing.

Course Outcomes:

- Describe the key concept in carrying out a process engineering drawing and software, application of conventional signs, symbols lettering and geometry. Implement the concepts in creating process drawing sheets and the objectives of engineering drawings.
- Know how to select the principal engineering drawing instruments needed in a process based on the process structure approach and to create a detailed process drawing sheets and professional technical drawings classified as drafting media and drafting equipment.
- Able to draw different types of orthographic representations related to view projections, space drawing views, circular features, types of pictorial drawings related to view projection including piping systems.
- Identify the concept of computer aided drawing using AUTOCAD. Able to determine dimensioning sectional views and selecting hatch patterns from AUTOCAD.

- Able to prepare and draw proper drawing sheets of a typical chemical plant using PROCEED.

References:

1. Jensen C., Hales J.D. and Short D.R., 'Engineering Drawing and Design', 7th edition, Mc Graw-Hill Boston, 2008.
2. Gary R. Bertoline and Eric N. Wiebe, 'Fundamentals of Graphics Communication', International edition Mc Graw-Hill Co., USA, 2003.
3. James A Leach.' AutoCAD 2009 Instructor, 5th Edition, Mc Graw-Hill Co., USA, 2009

EEU104/3 Electrical Technology

Objective: To study characteristics of various elements of electrical engineering and analyze the electrical circuits and magnetic devices.

Synopsis:

Units, Definitions, Experimental Laws and Simple Circuits
System of units, charge, current, voltage, and power types of circuits and elements. Ohm's law, Kirchhoff's laws, analysis of a single-loop current, single node-pair circuit, resistance and source combination, voltage and current division.

Circuit Analysis Techniques
Nodal and mesh analyses, linearity and superposition, source transformations, Thevenin's and Norton's theorems.

Inductance and Capacitance
The V-I relations for inductor and capacitor, inductor and capacitor combinations, duality, linearity and its consequences.

Source-free Transient Response of R-L and R-C Circuits
Simple R-L and R-C circuits, exponential response of source free R-L, R-C circuits.

Response to Unit Step Forcing Function
Response of R-L and R-C circuits to unit step forcing functions.

Response to Sinusoidal Forcing Function
Characteristic of sinusoidal forcing functions, response of R-

L and R-C circuits to sinusoidal forcing functions.

Phasor Concept
The complex forcing function, the phasor, phasor relationships for R, L and C, impedance and admittance

Average Power and RMS Values
Instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power.

Power System Circuits
An overview of single and three phase systems, wye and delta configurations of three circuits, wye and delta transformations, and power calculations in three phase systems.

Magnetic Circuits and Devices
Concept and laws of magnetism and analysis of transformers. Introduction to electromechanical energy conversion, operation of machines as generators and motors, power loss, efficiency and operations at maximum efficiency.

Course Outcomes:

- To be able to identify basic quantity and unit definitions.
- To be able to define the basic of electrical
- To be able to comprehend the principle of DC, Ac and transient circuit analysis.
- To be able to encapsulate the principle of magnetic device, magnetic circuit and transformer.

References:

1. Huges, "Electrical and Electronic Technology", 10th ed, Pearson Prentice Hill, 2008
2. Alexander and Sadiku, "Fundamentals of Electric Circuits", 3rd ed, Mc Graw Hill, 2007
3. Nilsson and Riedel, "Electric Circuits", 8th ed, Pearson Education, 2008

(Offered by School of Electric and Electronics Engineering)

EUM 114/3 Advanced Engineering Calculus

Objective: This course covers the concepts of linear algebra, Fourier series, partial differential equation and vector calculus. This course will provide students with a variety of engineering

examples and applications based on the above topics.

Synopsis:

Linear algebra

Determinants, inverse matrix, Cramer's rule, Gauss elimination, LU (Doolittle and Crout), eigen value and vector eigen, system of linear equation, numerical method for solving linear equation: Gause Seidel and Jacobian.

Fourier series

Dirichlet condition, Fourier series expansion, function defined over a finite interval, half- range cosine and sine series.

Vector Calculus

Introduction to vectors, vector differentiation, vector integration: line, surface and volume, Green's, Stoke's and Gauss Div theorems.

Partial differential equation

Method for solving the first and second order PDE, linear and non linear PDE, wave, heat and Laplace equations.

Course Outcomes:

- Defining the concept of linear algebra, fourier series, partial differential equations and vector calculus.
- Recognize and use mathematical operations involved in the learned concepts above.
- Using numerical methods to obtain solutions of the system of linear equations and partial differential equations.
- Apply the concept of learning outcomes above for solving problems related to engineering.

References:

1. Glyn J., (2010). Modern Engineering Mathematics, 4th Edition .Pearson
2. Glyn,J.,(2010). Advanced Modern Engineering Mathematics, 4th Edition.Pearson
3. Ramana, B.V (2007). Higher Engineering Mathematics, 1st Edition. Tata Mc Graw Hill
4. Peter V.O'Neil (2007). Advanced Modern Engineering Mathematics, 1st Edition .Thomson
5. Ron Larson, Bruce H. Edwards (2009), Calculus, 9th Edition, Brook Cole Steven.

(Offered by School of Electric and Electronics Engineering)

EKC 108/4 Physical and Analytical Chemistry

Objective: At the end of the course, the students will be able to acquire the basic concepts of thermodynamics and its associated laws. They will also acquire knowledge of liquid solutions behaviour in terms of ideal solution and ideally dilute solution as well as electrochemical system. For the analytical chemistry part, the students will acquire the ability to calibrate, operate and analyze both qualitatively and quantitatively using various analytical equipments such as UV/Vis, GC, HPLC and AAS.

Synopsis: This course will give the students the basic concept of First and Second Law of Thermodynamics. This will include perception of concept on heat, work, internal energy, enthalpy, entropy. The basic concept of solution behaviour will also be introduced including ideal and non ideal solutions as well as the electrochemical systems. In addition this course is also devoted to the fundamentals of qualitative and quantitative measurements with emphasis on spectrometry, common analytical equipment like UV/Vis, GC, HPLC, AAS. There will be a 4 hrs laboratory demonstration on the analytical equipment.

Course Outcomes:

- Explain the basic concepts of thermodynamics and its associated laws.
- Describe physical and thermodynamic properties of fluids.
- Describe the thermodynamic properties of different types of solutions.
- Describe the basic knowledge of electrochemical system.
- Use UV/VIS spectroscopy for quantitative analysis.
- Select and utilize appropriate analytical equipment for specific samples.
- Interpret data obtained from UV/VIS, GC, HPLC and AAS instruments.

References:

1. Peter Atkins and Julio de Paula, Atkins' 'Physical Chemistry', 7th Edition, Oxford University Press., 2002.
2. Skoog, D.A., West, D.M., and Holler, F.J., 'Fundamentals of Analytical Chemistry', 7th Edition, Harcourt College Publishing, 2000.
3. Alberty R. A, Silbey R.J., "Physical Chemistry", 2nd Edition., John Wiley, 1996.

EKC 109 Introduction to Project Management

Objective: The aim of this course is to provide basic knowledge on management of engineering project where students are able to practice the principles of engineering project management. Students will be able to plan, execute, supervise and evaluate the engineering project in groups. Students will also be trained to effectively solve the coursework, especially on the aspects that involve scope, time, cost, technical competency, assumptions and resistance in managing engineering project.

Synopsis: This course introduces some fundamental principles of engineering project management and the execution of a systematic and organized project. Students will learn in-depth the role of project manager as well as a team member of a project execution group, while building the skill to plan, construct scheduling, carry out monitoring and evaluation of the engineering project. This course also covers the teamwork skills including the engineering problem solving, communication, decision making and conflict management.

Course Outcomes:

- Systematically apply the principles of engineering project management
- Plan and coordinate engineering projects to meet the time, cost and other technical constraints
- Monitor engineering projects to meet the planning and develop contingency plans to face the project risks
- Evaluate engineering projects in term of optimum management and improvements to be made
- Use the visual aid and suitable presentation techniques as well as work effectively either as group member or group leader.

References:

1. Smith, Karl (2014), Teamwork and Project Management, Fourth Edition, Mc Graw Hill, New York.
2. Pinto Jeffrey K., (2013), Project Management. Achieving Competitive Advantage. Third Edition, Pearson Global Edition, Essex, England.
3. Lawson, G., Wearne and Smith, I.I (1998). Project Management For The Process Industries, IChemE, United Kingdom.

EKC 111/3 Mass Balance

Objective: The aim of this course is to provide knowledge on the concept and applications of mass balances for chemical engineering processes. At the end of this course, students will be able to convert a quantity expressed in one set of units into its equivalent in any other dimensionally consistent units using conversion factor tables. The students should also be able to identify and perform mass balances on open and closed systems with reactive and non-reactive processes.

Synopsis: This course is an introduction to the analysis of chemical processes with an emphasis on mass balances. Topics include an introduction to flow chart for the chemical industry, concepts of recycle, bypass and purge in mass balances for reactive and non-reactive systems. MS EXCEL is used to solve mass balance problems in chemical processes.

Course Outcomes:

- Identify the units commonly used to express both mass and weight in SI, cgs, AES and calculate weight from a given mass in either natural units or defined units.
- Convert and calculate quantity expressed in one set of units into its equivalent in any other dimensionally consistent units using conversion factor tables.
- Draw and label a flowchart, choose a basis of calculation and perform a degree-of-freedom analysis given a description of a steady state process.
- Write and solve mass balance equations for single unit/multi-units for reactive and non-reactive processes.

References:

1. Felder, R.M., and Rousseu R.W., 'Elementary Principle of Chemical Processes', John Wiley, 4th. Edition, 2005.
2. Himmeblau, D.M., 'Basic Principles and Calculation in Chemical Engineering', 6th Edition, Prentice-Hall, Eaglewood Clift, USA, 1996
3. Luyben, W.L., and Wenzel, L.A., 'Chemical Process Analysis: Mass and Energy Balances', Prentice Hall, Eaglewood Clift, USA, 1987.

EKC 212/4 Fluid Flow for Chemical Engineering

Objective: Students should be able to apply the basic principles of fluid flow for incompressible and compressible fluid and the theory of fluidization, flow pass immersed body, transportation, metering, mixing and related equipment.

Synopsis: This course will cover the basic principles of fluid transport including the phenomena of fluid and theories related to fluid static, incompressible fluid and compressible fluid. The student will also expose to mass and energy balances of fluid flow in conduits, transportation and metering of fluids, fluidization and flow past immersed bodies as well as agitation and mixing of liquids.

Course Outcomes:

- Carry out the dimensional analysis in various units systems common in fluid flow. Learn the properties of static fluid especially with respect to pressure and hydrostatic equilibrium and apply these properties in devices such as manometers and decanters.
- Describe the rheological characteristics of fluids and correlate with the laminar and turbulence flow.
- Apply continuity and Bernoulli equations with friction correction and pump work for incompressible fluid. Apply the properties of laminar & turbulent incompressible fluids in pipes and closed channels.
- Apply compressible fluid properties for an isentropic expansion, adiabatic frictional flow and isothermal frictional flow.
- Apply flow equation to the solid immersed in the fluid to calculate the drag coefficient and terminal velocity. Learn various types of fluidization and its phenomena.
- Learn different types of metering systems for the measurement of fluid flow. Learn different types of mixers and agitators for fluid mixing.

References:

1. McCabe, W.L., Smith, J.C and Harriott, P., "Unit Operations of Chemical Engineering", 7th Edition, Mc Graw Hill, 2005.
2. Holland, F.A., "Aliran Bendalir Untuk Jurutera Kimia", Karya terjemahan oleh Mohd Hakimi Ibrahim, DBP-USM 1991.
3. Coulson, J.M., Richardson, J.F., "Chemical Engineering, Vol I & II", Pergamon Press, 1991.

EKC 214/3 Energy Balance

Objective: The aim of this course is to provide knowledge on the concept and applications of energy balances for chemical engineering processes. At the end of this course, students will be able to describe various type of energies. The students should also be able to identify and perform energy balances on open and closed systems with reactive and non-reactive processes.

Synopsis: This course provides knowledge on the principles and application of the energy balance in chemical process industry. Students will be introduced to the forms of energy, tables of thermodynamics, concept of latent heats and energy balance for non-reactive and reactive processes.

Application of Microsoft Excel for solving energy balance problems will also be introduced as well as having industrial talk for industrial exposure.

Course Outcomes:

- Describe the basic concept of open system and closed system.
- Identify various types of energy.
- Analyze and use enthalpy charts, enthalpy diagram and enthalpy tables.
- Calculate the energy balance for non-reactive system.
- Explain the concepts of heat of reaction; heat of formation; heat of combustion; heating value of a fuel; and adiabatic flame temperature.
- Calculate the energy balance for reactive system.

References:

1. Felder, R. M. and Rousseu R.W., 'Elementary Principle of Chemical Processes', 3rd Edition, John Wiley, 2000.
2. Himmeblau D. M. and Riggs, J.B., 'Basic Principles and Calculation in Chemical Engineering', 7th Edition, Prentice-Hall, Eaglewood Clift, USA, 2004.
3. Luyben, W.L., and Wenzel, L.A., 'Chemical Process Analysis: Mass and Energy Balances', Prentice Hall, Eaglewood Clift, USA, 1987.

EKC 217/3 Mass Transfer

Objective: The aim of this course is to impart knowledge of diffusion and mass transfer. To train the students in gaining the competency to carry out calculations in process operations and design such as

absorption, distillation and extraction (liquid-liquid and solid-liquid). At the end of this course, students will be able to carry out chemical engineering calculations related to design of absorbers, distillation tower and extraction unit.

Synopsis: Students are introduced to the theories of diffusion and mass transfer. Basic principles of unit operations such as distillation, absorption and extraction are covered.

Course Outcomes:

- Carry out calculations on diffusion and mass transfer problems.
- Solve problems in absorption using the film theory of mass transfer as applied to absorption columns.
- Apply the principles of vapour liquid equilibrium in solving distillation problems.
- Apply the principles and theory of extraction.

References:

1. McCabe, W. L., Smith, J.C. and Harriott, P. 'Unit Operations of Chemical Engineering', International 7th Edition, 2005.
2. Treybal, R.E., 'Mass Transfer Operations', Mc Graw Hill, USA, 2000.
3. Seader, J,D. and Henley, E.J., 'Separation Process Principles', 2nd Ed., John Wiley & Sons, 2006

EKC 246/3 Computer Programming and Applications

Objective: The aim of this course is to provide knowledge of programming using MATLAB to solve chemical engineering problems and exposes students to simulation of chemical process plants. It also teaches students how to use chemical engineering modelling software which also introduced the techniques of estimating process conditions to facilitate process simulation. At the end of this course, students will be able to apply, design and code MATLAB programming for solving chemical engineering problems and represent information in graphical forms. The students should also be able to analyse and perform the simulation of chemical processes using software.

Synopsis: The course introduces the use of MATLAB in problem solving in engineering with a special emphasis on basic calculations in chemical engineering. It covers arrays, which are the basic building blocks in MATLAB; file usage, built in math functions, and user defined functions; programming using branch and loop constructs; 2-D and 3-D plots, and fitting data to models. Other tools such as Microsoft Excel will be used as well as MATLAB for solving linear and nonlinear equations

and function optimization. This course will also provide student with the knowledge of process simulation in chemical engineering design using software. This course also guide students through the key steps in process simulation modelling for chemical processes in which the students will gain hands-on experience on the techniques to troubleshoot common simulation problems.

Course Outcomes:

- Comprehend the features of MATLAB, including its windows, menu structures and the problem-solving methodology.
- Apply the fundamental data element such as the concept of arrays for basic mathematical operations in MATLAB.
- Apply the files (program and data files) and functions (build-in math functions, user-defined functions) relational and logical operators, conditional statements, *for* and *while* loops, switch structures and procedural statements in MATLAB.
- Apply graphical tools in MATLAB to represent information effectively.
- Design, code and test MATLAB programs that meet requirements of desired problems.
- Apply and utilize MATLAB programming tools in solving typical chemical engineering problems numerically and analytically.

Reference:

1. Palm, W. J. 'A Concise Introduction to MATLAB' Int-edn, McGraw-Hill, Inc., 2008.
2. Bruce A. Finlayson, 'Introduction to Chemical Engineering Computing', Wiley-Interscience., 2006.
3. Apen Plus Guidelines Vol 1-14 (2007)

EKC 271/3 Biotechnology for Engineers

Objective: Students should be able to describe the structural component of cell and its relationship to biological function. They also acquire the ability to apply microbial and enzyme kinetics principles of biochemical processes and sterilization techniques.

Synopsis: This course provides an overview of fundamental concepts in Biotechnology which are pertinent to Engineering and technology. Primary topics include: Cell, cell metabolic pathways, microbial growth kinetics both batch and continuous system, sterilization and enzyme kinetics.

Course Outcomes:

- Describe the importance of cell and its relation to biochemical pathways.
- Apply biochemical engineering principles of microbial kinetics in the design and analysis of batch, fed-batch and continuous bioreactor.
- Select and apply simple models of cell growth and product formation in cell culture.
- Outline the techniques of sterilization of biological reactors.
- Outline the importance of enzyme kinetics in biochemical reactions.
- Interpret scientific papers related to biotechnology.
- Describe a biotechnology based plant operation, safety and control.

References:

1. Ghasem D Najafpour, "Biochemical Engineering and Biotechnology" 1st edition, Elsevier B. V. Netherlands, 2007
2. Nielsen J. and Villadsen J., 'Bioreaction Engineering Principles', Plenum Press, New York, 2006.
3. Shuler M. L. and F. Kargi, "Bioprocess Engineering, Basic Concepts", Prentice Hall, New Jersey, 1992

EKC 216/3 Process Heat Transfer

Objective: At the end of this course, the student will be able to apply the concepts of heat conduction, convection, and radiation in the design and operation of heat exchanger, evaporator and furnace.

Synopsis: This course involves the introduction of different modes of heat transfer. The principles and basic calculations of heat transfer by conduction, convection and radiation will be covered. Heat exchange equipment such as heat exchangers are also included.

Course Outcomes:

- Apply the concepts of heat conduction for steady and unsteady state conditions.
- Describe the concepts of heat convection – natural and forced convection.
- Apply the concepts of radiation heat transfer.
- Describe the concepts of boiling and condensation heat transfer
- Design heat exchange equipment, furnace and evaporators.

References:

1. Holman, J.P., 'Heat Transfer' 9th Edition, McGrawHill, USA, 2002.
2. McCabe, W. L., Smith, J.C. and Harriott, P., 'Unit Operations of Chemical Engineering', International 7th Edition, 2005.

EKC 222/3 Chemical Engineering Thermodynamics

Objective: The students will acquire the ability to discuss the fundamental of chemical engineering thermodynamics and apply it in the chemical engineering processes.

Synopsis: This course introduces the concepts of chemical engineering thermodynamics including laws of thermodynamics, volumetric and thermodynamic properties of fluids, thermodynamics properties of fluids, thermodynamics applications, refrigeration and liquefaction, solution thermodynamics.

Course Outcomes:

- Identify and describe the concepts of chemical engineering thermodynamics.
- Identify and describe the volumetric and thermodynamic properties of fluids.
- Analyze the thermodynamics of flow processes.
- Apply the principles of thermodynamics in the refrigeration and liquefaction systems.
- Apply the concepts of thermodynamics in estimation of the properties to solutions and mixtures.

References:

1. Smith, J.M and Van Ness, H.C. "Introduction to Chemical Engineering Thermodynamic", 7th Edition, Mc Graw-Hill, 2005.
2. Cengel Y.A. & Boles M.A. "Thermodynamics : An Engineering Approach", 6th edn, McGraw-Hill, 2007.
3. Sandler, S.I., "Chemical, Biochemical and Engineering Thermodynamics", 4th edn, John Wiley & Sons, 2006.

EUP 222/3 Engineers in Society

Objective: To provide knowledge on ethics, management, law and financial accounting related to engineering industry and the related framework necessary for the effective conduct to the society and industry

Course Outcomes:

- Introduce the fundamental theoretical principles related to engineering ethics, basic law for engineers, engineering accounting and basic management.
- Practice the real understanding on the fundamental theoretical principles related to engineering ethics, basic law for engineers, engineering accounting and basic management.
- Appreciate the importance of the fundamental theoretical principles in actual construction industry

Synopsis: This course provides exposure to students the fundamentals principles of engineering ethics such as code of engineering ethics and the responsibility of a professional engineer, basic law covering introduction to Malaysian Laws, engineering accounts and basic introduction to management theory.

References:

1. Abdul Aziz Hussin & Abdul Rashid Abdul Aziz, (2000), Aspek Undang-undang Tort Dalam Projek Pembinaan, Pulau Pinang Penerbit Universiti Sains Malaysia.
2. Akta Pendaftaran Jurutera dan Peraturan, 1967 (Pindaan Sehingga 1998).
3. Boatright, J. R., (2000), 'Ethics and The Conduct of Business', New Jersey, Prentice-Hall.
4. Hairul Azhar Abdul Rashid, et. al., (2004), '*Engineers in Society*', Kuala Lumpur, McGraw Hill.

(Offered by School of Civil Engineering)

EKC 245/3 Mathematical Methods for Chemical Engineering

Objective: The aim of this course is to provide knowledge of engineering computational methods in solving chemical engineering problems. At the end of this course, students will be able to express real chemical engineering related problems in the form of mathematical equations, identify and solve them using numerical methods with the help of mathematical software.

Synopsis: This course will provide the knowledge of various numerical techniques in solving chemical engineering problems. Students will be introduced to error analysis, optimization techniques and numerical methods to solve Ordinary and Partial Differential Equations. Application of MATLAB and Microsoft Excel for solving numerical problems.

Course Outcomes:

- Express real chemical engineering related problems in the form of mathematical equations.
- Identify and solve linear and nonlinear single/sets of equations using numerical methods.
- Apply optimization to solve chemical engineering problems.
- Differentiate between regression and interpolation and implement the techniques to solve problems in chemical engineering practice.
- Demonstrate on how to implement or apply the ODEs and PDEs to solve particular ODE and PDE problems.
- Solve numerical problems using mathematical software.

References:

1. S.C. Chapra and R.P. Canale, 'Numerical Methods for Engineers', 5th. Edition, McGraw- Hill, 2005
2. J.B., Riggs, 'An Introduction to Numerical methods for Chemical Engineers', 2nd Edition, Texas Tech. University Press, 1994.
3. S.C. Chapra Applied Numerical Methods with MATLAB International Edition, 2nd edition, 2008, McGraw-Hill.

EKC 291/2 Chemical Engineering Laboratory I

Objective: The students will acquire the ability to carry out experiments and analyze experimental data of fluid flow and heat transfer equipments. They should also be able to obtain and interpret thermodynamics and equilibrium data.

Synopsis: This course would be an application of heat transfer and fluid flow through executing 20 Pilot Plant experiments in Unit Operation Laboratory which are related to chemical engineering principles.

Course Outcomes:

- Conduct experiments related to fluid flow phenomena. Identify, analyze and discuss the performance of the related fluid flow units.
- Conduct experiments related to heat transfer phenomena. Identify, analyze and discuss the performance of the related heat transfer units.
- Conduct experiment related to thermodynamics equipment. Identify and discuss the thermodynamics and principle of equilibrium data.

References:

1. Laboratory module for EKC 291
2. Coulson J.M. and Richardson J.F., 'Chemical Engineering Vol. 1 Fluid Flow, Heat Transfer and Mass Transfer', Butterworth-Heinemann, 2002.
3. Coulson J.M. and Richardson J.F., 'Chemical Engineering Vol. 2 Particle Technology and Separation Processes', Butterworth-Heinemann, 2002

EKC 316/4 Separation Processes

Objective: At the end of this course, the student will be able to apply the knowledge in mass transfer analysis in laminar and turbulent flow conditions to transform dimensional expression into dimensionless groups in simulating chemical engineering problems, and to make use of the conceptual correlations related to heat transfer and mass transfer in problems related to separation processes. Also, they will be able to carry out calculations on humidification, cooling towers, membrane separations, drying, crystallization, adsorption and filtration using graphical and theoretical approaches.

Synopsis: To introduce the theory of humidification and separation processes to the students. This includes mass transfer and the design criteria of processes such as drying, crystallization, adsorption, humidification, filtration, membrane processes and supercritical fluid extraction.

Course Outcomes:

- Apply the knowledge in mass transfer analyses in laminar and turbulent flow conditions. To transform dimensional expression into dimensionless groups in simulating chemical engineering problems. To make use of the conceptual correlations related to heat transfer and mass transfer problems.
- Solve problems on humidification using the psychrometric chart and chemical engineering design and operation of humidifiers.
- Solve problems in membrane processes and design/operation of membrane unit.
- Apply the principles and theory of drying in drying processes, and to select the industrial dryers for applications in drying.
- Demonstrate the understanding of principles and theory of crystallization. Apply the knowledge in the design and operation of crystallizers.
- Apply the basic theories of adsorption and

design/operation of adsorbers.
- Apply the principles and theory of filtration.
- Introduce the principles and theory of super critical fluid extraction.

References:

1. Mc Cabe W.L., J.C.Smith, P.Harriott, 'Unit Operations in Chemical Engineering', 7th ed. Mc Graw Hill, USA 2005.
2. Treybal, R.E., 'Mass Transfer Operations', McGraw Hill, USA, 2000.
3. J.D. Seader & E.J. Henley John, 'Separation Process Principles' 2nd Ed. John Wiley & Son, 2006.

EKC 336/3 Chemical Reaction Engineering

Objective: Students should be able to express basic concepts of reaction kinetics, chemical equilibria, design and evaluate operational performance of ideal, non-ideal, isothermal, non-isothermal, adiabatic, non-adiabatic of batch and flow reactors for homogeneous reactions by using computer software package.

Synopsis: This course contains knowledge on the principles of homogeneous reaction kinetics, reaction equilibria, isothermal and non-isothermal, ideal, non-ideal, adiabatic, non-adiabatic reactor design.

Course Outcomes:

- Define rate of reaction and mole balance in a batch and continuous flow reactors.
- Describe basic concept of chemical reaction equilibria in terms of standard Gibbs energy, and equilibrium constant for a single and multi reaction systems.
- Use rate laws and stoichiometry tables to solve problems on elementary reactions.
- Apply the understanding on concepts of reaction kinetics, rate law, reaction mechanism and dependence of rate constant on temperature to solve relevant problems.
- Analyze batch and continuous reactor operations for conversion and reactor sizing when operated under isothermal and non-isothermal modes.
- Apply concepts of integral and differential reactors for the determination of rate laws and parameters.
- Apply basic concepts of multiple reaction for the determination of conversion and selectivity in a PFR and CSTR.

- Analyze the distribution of residence times (RTD) functions for modeling of reactor.

References:

1. Fogler, H.S., 'Elements of Chemical Reaction Engineering', 4th Edition, Prentice Hall, New York, 2005.
2. Missen, R.W., Mims, C.A., Saville, B. A., 'Chemical Reaction Engineering and Kinetics', John Wiley & Sons, New York, 1999.
3. Smith J.M., 'Chemical Engineering Kinetics', 3rd Edition, McGraw-Hill, New York, 1981.

EKC 361/4 Process Dynamics and Control

Objective: The aim of this course is to provide knowledge of process dynamics and control in chemical and process industries. At the end of this course, students will be able to model and describe the dynamic behaviour of various simple chemical processes; design, apply and analyze typical type of controllers and describe enhanced single loop control strategies and basic process instrumentation.

Synopsis: This course will provide the knowledge of process dynamics and control in chemical engineering processes. It covers the concept of theoretical model, dynamic behavior of open and closed-loop systems, basic type of controllers, PID controller tuning procedures and controller stability criterion. This course also introduces enhanced single loop control strategies and basic process instrumentation.

Course Outcomes:

- Identify process control strategies for specific chemical engineering applications.
- Identify suitable instruments for various chemical processes.
- Develop input-output relationship of various chemical processes.
- Analyse the dynamic behavior of open loop systems and closed loop systems as well as the stability of closed loop systems.
- Design feedback controllers for various processes.
- Apply and analyze the PID controller tunings strategies.
- Apply and analyze enhanced single-loop control strategies .
- Describe the characteristics of the transfer function using Frequency Response (FR) analysis and apply the FR in control system design.

References:

1. D.E., Edgar, T.F., and Mellichamp, D.A., 'Process Dynamics and Control', 2nd Edition, John Wiley and Sons, 2004.
2. Bequette, B.W., 'Process Control, Modeling, Design and Simulation', Prentice Hall International, 2003.
3. Marlin, T.E., 'Process Control Designing Processes and Control Systems for Dynamic Performance', 2nd Edition, Mc Graw Hill, 2000.

EKC 378/3 Environmental Engineering and Management

Objective: The students will acquire the ability to discuss the current environmental laws locally and internationally, and will be able to understand overall purpose of Environmental Management System (ISO140001). The students will learn the 3R concept and waste minimization. They will also acquire the ability to discuss the essential element of wastewater, solid waste and hazardous waste treatment and management, air pollution control.

Synopsis: This course introduces the current environmental laws and the essential elements of environmental engineering and management. This includes introduction to environmental management system ISO140001, wastewater treatment, air pollution control, solid waste and hazardous waste management, 3R concept and waste minimization.

Course Outcomes:

- Describe the legislation and environmental act of Malaysia & International, and the principles of environmental pollution.
- Understand overall purpose of Environmental Management System (ISO 14001) that is associated with engineering activities.
- Describe the concepts and control measure for air pollution.
- Describe the concepts and control measure of wastewater treatment technologies.
- Describe the concepts and control measure of solid waste treatment technologies.
- Describe the concepts and control measure of Hazardous waste technologies.
- Understand sustainability, 3R (reduce, reuse, recycle) and waste minimization concept.
- Interpret scientific papers related to environmental issues.

References:

1. Kiely. G., 'Environmental Engineering', McGraw-Hill International (UK) Limited, 1997.
2. Eckenfelder, Jr, W.W., 'Industrial Water Pollution Control', 3rd Edition, McGraw-Hill International Edition, 2000.
3. Davis M. L & Masten S. J. 'Principles of Environmental Engineering and Science', 2nd Edition, Mc Graw Hill, 2008.

EKC 314/3 Transport Phenomena

Objective: Upon completion of the course, the students will be able to set up shell balances for conservation of momentum, energy and mass; understand and apply flux laws in balances, interphase transport relationships, solve appropriate equations to obtain desired profiles for velocity, temperature and concentration. The students will utilize information obtained from solutions of the balance equations to obtain engineering quantities of interest. The students will be able to recognise and apply analogies among momentum, heat and mass transfer. The students will appreciate relevance of transport principles in diverse applications of chemical engineering problems.

Synopsis: The course contributes primarily to the student's knowledge of transport processes in chemical engineering by providing molecular level understanding of transport processes and establishing the modeling tools (mathematics and physics) to predict macroscopic behavior of real systems. This course develops the skills and tools needed for engineering practice, especially for extension of new models to new systems. The course describes the underlying physical processes involved in transport of momentum, heat and mass. This information supports the empirical models for transport parameters widely used in many unit operations analyses.

Course Outcomes:

- Carry out calculations on transport properties and momentum transfer problems for laminar and turbulent flow in Isothermal systems.
- Apply the principles of Energy transfer to nonisothermal systems and solve the problems related with temperature distribution in the systems.
- Apply the principles of Mass Transport and solve the problems of Inter-phase transport in Isothermal and Nonisothermal systems.
- Solve the elementary problems involving momentum transfer, heat transfer and mass transfer for isothermal and nonisothermal systems.

References:

1. Bird, R.B., Stewart,W.E, and Lightfoot, E.N; 'Transport Phenomena', 2nd Edition, Wiley& Sons, New York,2002.
2. Plawsky, J.L; 'Transport Phenomena Fundamentals', Marcel Dekker, New York, 2001.
3. Brodkey, R.S. and Hershey, H.C; 'Transport Phenomena: A unified Approach', McGraw-Hill, New York, 1988.

EKC 337/4 Reactor Design and Analysis

Objective: At the end of this course, the student will be able to design conventional catalytic reactor, multiphase reactors and bioreactors. The students will also have necessary knowledge on the preparation and characterization of different types of catalysts needed for industrial processes.

Synopsis: The student will be exposed to design conventional catalytic, multiphase reactors and bioreactors. Sufficient knowledge on the preparation and characterization of different types of catalysts needed for industrial processes will also be given.

Course Outcomes:

- Understand sustainability, 3R (reduce, reuse, recycle) and waste minimization concept.
- Describe and formulate rate expressions for main steps involved in a solid-catalyzed reaction and to analyze the catalytic system for rate-limiting steps.
- Describe and apply different types of laboratory scale reactor to determine the rate equations and model parameters.
- Formulate and apply expressions for external and internal diffusion effects in analyzing catalytic and non catalytic reaction systems.
- Describe catalysts preparation methods and its characterization.
- Describe the kinetics of fluid-particle reactions.
- Describe and apply different types and operations of bioreactors/fermenters.
- Design different types of fluid-particle reactors.
- Solve problems in chemical reaction engineering using computer software package.

References:

1. Octave Levenspiel, 'Chemical Reaction Engineering', 3rd Edition, John Wiley & Sons, 1999.
2. H. Scott Fogler, 'Elements of Chemical Reaction Engineering', Fourth Edition, Prentice-Hall, 2005.
3. Andersson,J.R. and Pratt, K.C. 'Introduction to Characterization and Testing of Catalysts, Academics', New York, 1985.

EKC 367/3 Plant Safety

Objective: The aim of this course is to provide knowledge of safety in the chemical and process industries. At the end of this course, students will be able to understand and use safety concepts in identifying major hazards and conducting risk assessment associated with the hazards. Student will also be able to use safety concepts in chemical engineering designs to ensure the plant is inherently safer.

Synopsis: This course provides the principles knowledge related to safety in chemical and process industries. It covers to the introduction of safety concept, industrial hygiene, characteristic of major hazards, derivation of mathematical model related to leakages and dispersion. Students will be also taught hazard identification and risk assessment techniques. Finally, the use of safety concept in designing chemical plant to produce Inherently Safer Plant.

Course Outcomes:

- Describe the basic concepts of process safety.
- Identify various phases of Industrial Hygiene.
- Characterize major hazards (fire, explosion and toxic release).
- Derive mathematical equations related to any leakage and dispersion of chemicals from containers and pipes.
- Use hazard identification techniques to identify possible hazards in chemical and process industries.
- Use Risk Assessment Techniques to predict the possible risks from chemical and process industries.
- Apply safety concepts to design of chemical equipments.

References:

1. Crowl, D.A and Louvar, J.F, 'Chemical Process Safety, Fundamentals with Applications', Prentice Hall, New Jersey, 2000.
2. Frank, P.L, 'Loss and Prevention in the process industries', Volume 1&2, London, Butterworth, 1980.
3. Coulson, J.M and Richardson, J.F, 'Chemical Engineering', Volume 6, Pergamon Press, Oxford, 1983.

EKC 394/2 Chemical Engineering Laboratory II

Objective: Students will be able to apply the practical concepts of heat and mass transfer, environment and petroleum product analysis. The aim of this course is to provide hands-on application of mass transfer and heat transfer phenomena to students, from which they will have to handle and run by themselves the pilot plant processes and bench scale reactions as well as the analytical equipment under the supervision of lecturers and technicians.

Synopsis: This course would be an application of heat transfer, mass transfer and combined heat and mass transfer through executing experiments in Unit Operation Laboratory, which is related to chemical engineering principles. The course also covers the experiments related to environment and petroleum product analysis.

Course Outcomes:

- Conduct experiments related to Mass transfer phenomena. Identify, analyze and discuss the performance of the related mass transfer units.
- Conduct experiments related to heat transfer phenomena. Identify, analyze and discuss the performance of the related heat transfer units.
- Conduct experiments related to the combined heat and mass transfer phenomena. Identify, analyze and discuss the phenomena of the related combined heat and mass transfer units.
- Conduct experiments related to environment and petroleum product analysis.

References:

1. 'Laboratory Manual, Chemical Engineering Laboratory II', School of Chemical Engineering, USM, Engineering Campus, Nibong Tebal. 2009.
2. Perry, R.H., and D. Green, eds, Perry's Chemical Engineers Hand Book, 7th Edition, McGraw-Hill, New York, NY 1997.
3. McCabe, W. L., Smith, J.C. and Harriott, P. 'Unit Operations of Chemical Engineering', International 7th Edition, 2005.

EKC 376/3 Downstream Processing of Biochemical and Pharmaceutical Products

Objective: The students will be able to efficiently integrate the separation processes required for the purification of the

biochemical and pharmaceutical products.

Synopsis: This course gives an overview of possibilities and problems typically associated with the recovery of biochemical and pharmaceutical products. It focuses on the concentration, recovery and isolation of the biological molecules relevant in biochemical and pharmaceutical industries. The principles, advantages and limitations of centrifugation, membranes, cell disruption, two-phase extraction, precipitation crystallization and chromatography are discussed. The integration of bioseparation schemes will be emphasized with specific applications.

Course Outcomes:

- Solve problems in chemical reaction engineering using computer software package.
- Select and apply a correct process for a particular downstream separation.
- Describe the application downstream processing in bioprocess system.

References:

1. Baily J. E. and Ollis D. F., 'Biochemical Engineering Fundamentals', 2nd Edition, McGraw-Hill, New York, 1986.
2. Ghosh, R. 'Principles of Bioseparations Engineering',World Scientific, 2006.
3. Belter, P.A., Lussler, E.L. and Hu, W.S. 'Bioseparation: Downstream Processing for Biotechnology", Wiley Interscience, 1988.

EKC 377/3 Renewable and Alternative Energies

Objective: On completion of the course, the students will be able to learn about the different forms of energy: Fossil Fuel, Renewable and Alternative energy. The student will learn design and performance of renewable energy system based on Biomass, Solar thermal, Photovoltaic (PV) and Wind. The student will also learn about the alternative energy system design and performance with emphasis on Fuel Cell system, Hydrogen Technologies, Bio-fuel production from sustainable resources. The student will be able to apply cost benefit analysis on each form of alternative energy for its suitability to the large scale system. The student will be able to understand the importance of clean energy, Green power and global warming.

Synopsis: This course will cover with the issues of renewable energy and alternative energy sources. The sustainable energy will

include biomass utilization and conversion technologies, solar energy generation including energy collection, storage, and its applications, Photovoltaic, wind farms and collection devices. The alternative energy will include fuel cell performances, types of fuel cells, fuel cell systems, basic thermodynamics and heat/mass transfer in fuel cell systems, biofuel production from bioresources; hydrogen based technologies including storage of hydrogen. The course will analyze in terms of cost benefit, energy solutions and cost comparison. The analysis will be project based and will provide solution in terms of nature of energy, its resources, energy conservation and efficiency. The economic and environmental effects of energy use will be included.

Course Outcomes:

- Apply the knowledge of different types of energies including Renewable and Alternative energies, their usage and their impact on the environment.
- Solve the problems related with design, operation and performance of Biomass utilization and other bioresources utilization systems in the production of alternative fuels and energies.
- Apply the principles and theory of Fuel Cell technology in the design and operation of different types of fuel cells for meeting energy needs.
- Demonstrate the understanding of principles and theory of different types of alternative energies. Apply the knowledge in the design and operation of the systems utilizing solar and wind energies.
- Solve the problems related with design, operation and economics of the systems using different types of alternative energies.

References:

1. Sorensen, B; 'Renewable Energy', 3rd Edition, Academic Press, 2004.
2. Kruger, Paul; 'Alternative Energy Resources: The quest for Sustainable Energy', Wiley, NY, 2006.
3. Aldo, V., deRosa; 'Fundamentals of Renewable Energy Processes', Academic Press, 2005.

EKC 451/4 Process Design and Analysis

Objective: On completion of the course, the students will be able to work in a group to synthesize, integrate and analyze a complete process plant to manufacture a product, to develop and specify the mass and energy balances of a major section of the process plant, to specify and design major pieces of

process plant equipment and to incorporate heat integration using pinch technology in the complete design of a process plant. The students will be able to defend the aspects of the design both in the written form and orally in formal presentations.

Synopsis: To introduce the preliminary design of chemical process plant to the students. This includes process creation and analysis, synthesis of separation trains, heat and power integration and process equipment design. ASPEN PLUS II will be implemented through out the course in the process flow sheeting and equipment design.

Course Outcomes:

- Apply the key steps in carrying out a process synthesis of a typical Chemical Process Plant.
- Identify the steps in creating process flow sheets involving reactions, separations and other operations using Process Synthesis and Integration approach.
- Recognize to select the principal equipment needed in a process based on the process structure approach. Apply heuristics in selecting separation processes and distribution of chemicals in the process operations.
- Demonstrate the design of mass transfer equipment, heat transfer equipment and reactors.
- Calculate the power input and output of the common types of pumps, compressors, expanders and agitated vessels.
- Calculate the minimum energy requirements of a process plant. Apply pinch technology in the design of heat exchanger network (HEN).
- Interact with industrial personnel and recognize the role of chemical engineer in operation of chemical plant.

References:

1. Seider, Warren D, Seader, J D, and Lewin, Daniel R, 'Product and Process design principles: synthesis, analysis and evaluation','2nd Edition, New York, Wiley, 2004.
2. Douglas, James M, 'The conceptual design of chemical processes', New York, McGraw-Hill, 1998.
3. Coulson, J. M., Richardson, and Sinnott, R.K., 'Chemical Engineering Design. Vol 6', 4th Edition, Butterworth-Heinemann, 2006.

EKC 493/2 Chemical Engineering Laboratory III

Objective: The students will acquire the ability to carry out experiments and analyze experimental data in various unit operation equipment such as heat transfer equipment, process control equipment, chemical reaction and environmental treatment and separation processes**.**

Synopsis: This course covers experiments on chemical reactions, mass transfer, heat transfer, separation processes, process control and environmental treatment. The experiments are: Air Pressure System, Air Flow System. Air Temperature System. Boiler Drum and Heat Exchanger – Pilot Plant 1, Boiler Drum and Heat Exchanger – Pilot Plant 2, pH Control (Pilot Plant). Heat Exchanger Control. pH Control (Bench). Level and Flow Control (Bench). Level Transmitter Calibration and Level Dynamics. Coagulation and Flocculation, Sedimentation, PM10, Continuous Stirred Tank Reactor, Filter Press, Plug Flow Reactor, Heavy Metal Removal, Aeration Unit and Solid Handling.

Course Outcomes:

- Carry out a line tracing and manipulate process variables and control variables for chemical plant with process control system.
- Demonstrate the application of separation and solid handling equipment.
- Demonstrate the basic concept of various treatment systems related to air and water pollution to carry out testing on waste water treatment and work on air emissions devises.
- Demonstrate the understanding, conceptualize and distinguish the different modes of reactor operation, reaction engineering and reaction kinetics.

References:

1. Laboratory Manual EKC 493.
2. Perry's 'Chemical Engineering Handbook', Perry, R.H.; Green, D.W. (eds). 7th Edition, 1997.
3. Mc Cabe W.L., J.C.Smith, P.Harriott, 'Unit Operations in Chemical Engineering', 7th edition. Mc Graw Hill, USA 2005.

EKC 475/3 Wastewater Treatment Engineering

Objective: Students will acquire the ability to interpret physical, chemical and biological treatment of wastewater; the design of aerobic and anaerobic treatment processes including advanced treatment of wastewater. Also will be able to understand treatment, reuse and disposal of solids and biosolids produced from wastewater**.**

Synopsis: This course contains physical, chemical, advanced and biological treatment of wastewater including design, operation, analysis and troubleshooting of treatment plant. In addition it also deals with treatment, reuse and disposal of solids and bio-solids produced during wastewater treatment processes.

Course Outcomes:

- Classify different categories of wastewater treatment processes, treatment methods involved, together with key elements of conceptual treatment process design.
- Apply the knowledge on the operation and control of various physical and chemical treatment processes for specific purposes in wastewater treatment to subsequently design the appropriate wastewater treatment units.
- Discuss and apply the theory of various advanced treatment processes for specific purposes in wastewater treatment with the final aim of designing the related treatment units.
- Analyze and discuss the integration of physical and chemical treatment processes with to be used in the treatment of wastewater generated by selected industries.
- Analyze the operation and control of various aerobic and anaerobic wastewater treatment processes with the objective of designing the related facilities.
- Recognize the advanced and emerging technologies in biological treatment processes of wastewater to be used in the treatment of specific type of industrial wastewater.
- Describe the suitable treatment methods, handling procedure, reuse and disposal of biosolids generated by the wastewater treatment processes.

References:

1. Metcalf & Eddy, Inc, 'Wastewater Engineering: Treatment, Disposal and Reuse'; 4th Edition, Mc Graw-Hill (2004).
2. W.W. Eckenfelder, Jr., 'Industrial Water Pollution Control', 3rd Edition , Mc Graw Hill, 2000.

3. M.L. Davis and D.A. Cornwell, 'Introduction to Environmental Engineering', 2nd Edition, Mc Graw-Hill, 1991.

EKC 483/3 Petroleum and Gas Processing Engineering

Objective: The course provides students the knowledge about petroleum refining and natural gas processing industries. This includes fundamental in evaluating the performance of various refinery operation units, understanding of various crude oil and natural gas processing technologies, understanding of the world wide LNG industries; production, storage and transport and marketing issues, and conversion of natural gas into methanol and other chemicals, petrochemicals and fuel cell.

Synopsis: The students will be able to understand the operations of downstream processing units of petroleum refining plant and natural gas treating processes. The student will learn about crude oil and petroleum products properties and specifications. The student will gain knowledge about the operation of petroleum refinery and natural gas processing units.

Course Outcomes:

- Develop an understanding on the importance of world petroleum crude oil and petroleum processing industries.
- Apply knowledge of chemical engineering fundamentals in evaluating the performance of various refinery operation units.
- Describe a detailed understanding of various crude oil processing technologies in a petroleum refinery.
- Develop an in-depth knowledge and advanced understanding of natural gas processing and the production of associated natural gas liquids and LNG.
- Develop an understanding of the world-wide LNG industry, including production, storage, transport and marketing issues.
- Apply knowledge of the science, engineering and economics involved in the conversion of natural gas into methanol, other chemicals, petrochemicals and fuel cell.

References:

1. James H. Gary and Handwerk E. Glenn, 'Petroleum Refining Technology and Economics', 4th Edition, Marcel Dekker, New York, 2001.
2. Katz L. Donald and Robert L. Lee 'Natural Gas Engineering Production and Storage' McGraw Hill Book Co. , N.Y., 1990.
3. Jones D.S.J. 'Elements of Petroleum Processing' John Wiley & Sons, Singapore, 1996.

EKC 453/4 Plant Design and Economics

Objective: On completion of the course, the students will be able to work individually and in a group to design a complete chemical process plant. The students will be able to do the cost estimation, profitability analysis, piping and instrumentation, plant wide control, waste management and life cycle assessment, plant safety, reliability and operability, plant layout, plant start up, commissioning and shutdown. The students will be able to defend the aspects of the design both in the written form and orally in formal presentations.

Synopsis: The course utilizes the knowledge gained by the student's in earlier courses and applies in the complete design of a Chemical Process Plant. The plant design includes cost estimation, profitability analysis, piping and instrumentation, plant wide control, waste management and life cycle assessment, plant safety, reliability and operability, plant layout, plant startup, commissioning and shutdown. ASPEN PLUS II will be implemented through out the course in the chemical process plant design and economic analysis.

Course Outcomes:

- Apply the key steps in creating a piping and instrumentation diagram (P&ID) of a typical Chemical Process Plant. To identify potential control problems and suggest plant wide control structure.
- Calculate the cost estimation of the various types of process equipment, utilities and other facilities required in a typical Chemical Process Plant using correlations and software.
- Apply different methods of Profitability analysis based on Capital cost and other cost data of a typical chemical Process Plant to determine the economics of the process plant.
- Calculate the minimum energy requirements of a process plant. Apply pinch technology in the design of heat exchanger network (HEN).
- Identify the key steps to be followed in the plant Startup and shutdown of a typical Chemical Process Plant.
- Perform a Comprehensive Risk assessment of a typical Chemical Process Plant incorporating safety, environment, health, social and economic issues.
- Describe about a Process Plant operation, Safety, Management and day to day trouble shooting problems in a typical chemical process plant.

References:

1. Seider, Warren D, Seader, J D, and Lewin, Daniel R, 'Product and Process design principles: synthesis, analysis

and evaluation', 2nd Edition, New York, Wiley, 2004.
2. Peters, M.S. and Timmerhaus, K.D., 'Plant Design and Economics for Chemical Engineers', 5th Edition, New York, McGraw-Hill, 2003.
3. Richard Turton, Richard C. Bailie, Wallace B. 'Whiting and Shaeiwitz A. Joseph: Analysis, Synthesis and Design of Chemical Processes', Prentice Hall, N.J. (USA), 1998.

Pre-Requisite Course: EKC451/4 - Process Design and Analysis.

EKC 499/6 Final Year Project

Objective: At the end of the course, students will be able to carry out research projects on an individual basis and report their research findings or results through written and/or oral forms.

Synopsis: This course provides the platform for carrying out individual research on specific areas in chemical engineering. This project involves literature survey, theoretical analysis, computer modelling and/or design of experiment, also development of experimental setup, data analysis and presentation of results in terms of oral and written report.

Course Outcomes:

- Use various methods or sources for finding literature materials and analyze their contents for relevance and appropriateness to the research project undertaken.
- Propose suitable models to be analyzed and/or design appropriate experiments to be carried out to address the specific research objectives.
- Collect appropriate experimental data using experimental systems and/or from published/ unpublished literature for modelling using suitable software packages.
- Discuss and analyze the research findings and compare them with any reported results in order to generate suitable conclusions.
- Assemble the research background, methods, results and findings and subsequently report them in the form of written dissertation following the desired formats.
- Demonstrate the ability and skill to deliver the research materials in the form of oral presentation.

Reference:

1. Academic journals.
2. Conference articles.
3. Academic books.

EKC 462/3 Advanced Control Systems for Industrial Processes

Objective: The aim of this course is to provide knowledge of advanced process control in chemical and process industries. At the end of this course, students will be able to describe and apply the advanced control strategies, multi-loop and multi-variable systems, model-based control strategies and systems with large dead time.

Synopsis: This course will introduce the concepts of advanced control strategies, multi-loop and multi-variable control as well as model-based control strategies. This course will also introduce the control concepts for systems with large dead time.

Course Outcomes:

- Describe advanced control concepts for enhancement of control performance.
- Discuss the difficulties in controlling systems with large dead times and design suitable dead-time compensators.
- Describe the multivariable nature of industrial processes and to apply multi-loop controllers and multivariable controllers.
- Describe and design Model Predictive Control.
- Describe and design Internal Model Control.

Reference:

1. Bequette, B.W., 'Process Control, Modeling, Design and Simulation', Prentice Hall International, 2003.
2. D.E., Edgar, T.F., and Mellichamp, D.A., 'Process Dynamics and Control', 2nd Edition, John Wiley and Sons, 2004.
3. Marlin, T.E., 'Process Control Designing Processes and Control Systems for Dynamic Performance', 2nd Edition, Mc Graw Hill, 2000.

Pre-Requisite Course: EKC361/4 - Process Dynamics and Control

EKC 463/3 Advanced Process Safety Engineering

Objective: The aim of this course is to provide the advanced knowledge related to process safety engineering. At the end of this course, students will be able to learn advanced techniques such as accident causal theory, human factor analysis, system safety engineering and computer aided modeling of major hazards. In additions, students will also learn the advanced risk assessment analysis and also the application of Inherent Safer Concept in designing a chemical plant.

Synopsis: This course covers industrial accident analysis, human factor principle and analysis, system safety engineering, computer aided modeling of major hazards. It also covers advanced risk assessment and application of Inherent Safer concept in designing a chemical plant.

Course Outcomes:

- Analyze factors contributing to accidents in the process industries
- Apply reliability analysis on equipment for the development of a chemical plant
- Analyze the impact of major hazard by using computer
- Design a chemical plant with the use of Inherent Safer concept

Reference:

1. Spellman Frank R, "Safety Engineering: Principles and Practice", Government Institute, 2nd Edition 2004.
2. Guidelines For Engineering Design For Process Safety, American Institute of Chemical Engineers (1993).
3. Trevor Kletz, "What Went Wrong?", 4th Edition, 2011.
4. Daniel A. Crow, Joseph F Louvar, "Chemical Process Safety, Fundamentals with Application", 2nd Edition, Prentice Hall, 2002.
5. Roland Harold E, "System Safety Engineering and Management", 2nd Edition, 1990.

Pre-Requisite Course: EKC 367/3 - Plant Safety

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STUDENTS' FEEDBACK

The aim of this feedback form is to obtain students' response regarding the contents of this Guidebook. The information obtained will be useful in improving it.

Please respond to items 1 – 5 below based on the following 4-point scale:

1 = Strongly disagree	2 = Disagree	3 = Agree	4 = Strongly agree

1. This Guidebook is very useful.

1	2	3	4

2. The information provided in this Guidebook is accurate.

1	2	3	4

If you choose 1 or 2 for Question no. 2, please state the page number that contains information that is inaccurate in the space below:

3. The information provided in this Guidebook is clear and easy to understand.

1	2	3	4

4. On the whole, the quality of this Guidebook is good.

1	2	3	4

5. I prefer to use CD compared to this Guidebook.

1	2	3	4

6. If you think other information should be included to make this Guidebook better, please write your suggestions in the space below:

Please submit this feedback form to your School's General Office in the 4th week of Semester I, Academic Session 2017/2018.